DOCUMENT RESUME

ED 457 911 JC 010 667

AUTHOR	Miller, Nancy Carol
TITLE	Perceptions of Motivation in Developmental Mathematics Students: I Would Rather Drill My Own Teeth.
PUB DATE	2000-12-00
NOTE	203p.; Doctoral Dissertation, University of Texas, Austin.
PUB TYPE	Dissertations/Theses - Doctoral Dissertations (041)
EDRS PRICE	MF01/PC09 Plus Postage.
DESCRIPTORS	*Community Colleges; *Developmental Studies Programs; Mathematics Achievement; *Mathematics Anxiety; *Remedial Mathematics; *Student Attitudes; *Student Motivation; Two Year Colleges

ABSTRACT

The purpose of this dissertation was to describe motivation in developmental mathematics students, particularly in low-performing students. Data collection involved interviews with developmental mathematics faculty members who were asked to describe the motivation of developmental mathematics students, analyses of student learning journals, and emergent interviews with developmental mathematics students who were not successfully completing their courses. Most low-achieving students fell into one or more categories: (1) mathematics anxiety; (2) job, class, and/or family responsibility overload; and (3) lack of perception of the relevance of mathematics. Many students allowed emotions or attitudes to influence their motivation to learn mathematics. However, with early success in their mathematics classes or instilled beliefs that mathematics was useful or interesting, many students began to move beyond the barriers by constructing new motivations. The primary finding connects cognition with motivation. It was found that motivation was not necessarily a precursor to understanding. Rather, understanding mathematics seemed to enhance students' motivation to learn. (Contains 79 references.) (GC)

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Perceptions of Motivation in Developmental Mathematics Students: I Would Rather Drill My Own Teeth

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Perceptions of Motivation in
Developmental Mathematics Students:
I Would Rather Drill My Own Teeth

by

Nancy Carol Miller, B. S., M. S. T.

Dissertation

Presented to the Faculty of the Graduate School of
The University of Texas at Austin
in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

The University of Texas at Austin
December, 2000

Perceptions of Motivation in
Developmental Mathematics Students:
I Would Rather Drill My Own Teeth

Approved by
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Dedication

This dissertation is dedicated to my family John, Kit, Andrea, Coley, Caroline, my parents, Clarence and Wilda Sanders, and to God for His grace to me.

Acknowledgements

I acknowledge the support of my peer debriefing group, Cody Brady, Lynda Abbott, and Carolyn Awalt, who listened, read, and discussed the study with me for months. I acknowledge the support and help of Michael J. McCarthy, Ph.D. who worked with me and questioned me concerning ideas and writing. Diane Schallert, Ph.D. suggested using student journals to collect the data.

Perceptions of Motivation in
Developmental Mathematics Students:
I Would Rather Drill My Own Teeth

Publication No._____

Nancy Carol Miller, Ph.D.
The University of Texas at Austin, 2000

Supervisor: Ralph Cain

This dissertation is a naturalistic inquiry into perceptions of motivation in developmental mathematics students at a community college. The purpose of this study was to describe motivation in developmental mathematics students with a particular focus on the low achieving students. The data generation began with emergent interviews of developmental mathematics faculty members who were asked to describe the motivation of developmental mathematics students, continued with the primary data generated by student learning journals, and concluded with emergent interviews with developmental mathematics students who were not successfully completing their courses. The findings are reported in

view of achievement motivation theories including goal theories, extrinsic and intrinsic motivation theories, and attribution theories. Most low achieving students fell into one or more of the categories that were 1) mathematics anxious, 2) overloaded by job, classes, and/or family and/or 3) lacking perceptions of the relevance of mathematics. Singly and taken together the categories may pose barriers to success for some students. Many students allowed emotions or attitudes to influence their motivation to learn mathematics. However, with early success in their mathematics classes or instilled beliefs that mathematics was useful or interesting, many students began to move beyond the barriers by constructing new motivations. The primary finding connects cognition with motivation. It was found that motivation was not necessarily a precursor to understanding. Rather, understanding mathematics seemed to enhance students' motivation to learn mathematics.

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CHAPTER 1. INTRODUCTION

The Problem

About half of all students entering community colleges are under prepared and require some developmental education (McCabe and Day, 1998). More students require developmental mathematics than other developmental courses (Lazarick, 1997). The motivation of low achieving students and other students in developmental mathematics courses at the post-secondary level clearly needs substantial and thorough investigation. Developmental mathematics involves mathematics knowledge and skills that are prerequisite to college level mathematics, science, economics, and technology courses. The students in developmental mathematics are diverse. This population includes non-traditional (usually refers to students over 25 years old), returning students, younger students, international students, students with GEDs, and students with special needs. Many of these students lack confidence in their ability to learn mathematics. Many of these students have experienced failure and frustration in learning mathematics in the past. It is common to find developmental mathematics programs in which 50% of the students do not succeed according to educators from across the nation and the *Crossroads in Mathematics: Programs*

Reflecting the Standards (1999). Some state legislatures have even mandated that success rates must improve. In many states there have been challenges on developmental education and limits set on these programs (McCabe & Day, 1998). Hodges, Corkran, and Dochen (1997) indicated that remediation costs in Texas were $153 million per biennium in their discussion with Ashworth. Boylan (1999) explained that students, parents, administrators, some instructors, and legislators complain that developmental courses take too long, cost too much, and hold students back from progress.

I initially became aware of the problems concerning the success rate of developmental mathematics students and issues related to student motivation while teaching developmental mathematics in several community colleges. From my interactions with other developmental mathematics professors from across the nation, I increasingly became aware of the widespread need for a better understanding of student motivation to learn developmental mathematics.

State governments are not likely to continue to fund developmental mathematics programs that repeatedly enroll students who fail to complete course work. Florida, for instance, has set a limit on state funding for any student taking a developmental course. Texas limited the number of developmental education semester hours to eighteen hours in universities and twenty-seven hours in community colleges.

In view of the limited resources that governments are willing to spend on developmental education, some educators are calling for research on motivation to improve the likelihood that students will successfully complete the courses. Some educators want to inspire students to exert the effort and time required to learn developmental mathematics without repeating courses even when students say "I would rather drill my own teeth" than do word problems. This dissertation was a study of perceptions of motivation in developmental mathematics students using naturalistic inquiry.

Focus of Inquiry

In this descriptive study I investigated what motivated low achieving, typical, and very successful students in developmental mathematics courses giving special attention to perceptions of low achievers. A clearer and more comprehensive understanding of the authentic motivations of developmental mathematics students has resulted from this study. The purpose of this study was to describe motivation in developmental mathematics students with a particular focus on the low achieving students. An additional purpose of the study was to add to the body of valuable motivation literature while not attempting to prove or disprove existing theories.

I asked students, during a given semester, to write in their student learning journals about their motivations, goals, emotions, beliefs, attitudes, and study habits related to learning mathematics. The students were instructed in their learning journals to freely modify and supplement any of their explanations, on an on-going basis, during the entire semester. The questions were primarily stems or open-ended statements for completion including two rankings of lists of important goals for learning mathematics and of course focus statements. Students, referred to me by the non-course based remediation coordinators at the community college, were asked to describe their motivation to learn developmental mathematics based on their experiences. Instructors were asked to describe their perceptions of what motivates developmental mathematics students to learn.

The students in the student learning journal entries described their own perceptions of motivation to learn mathematics. In some cases, students explained how this motivation was constructed. The recorded statements of the instructors who participated described their perceptions of motivation to learn in some developmental mathematics students. This naturalistic inquiry of motivation in developmental mathematics students was guided by the following questions:

- For students: What is your understanding of your motivations, beliefs, emotions, attitudes, study habits, and goals related to learning developmental mathematics at the post-secondary level?
- For instructors: What is your understanding of motivation in developmental mathematics students in post-secondary education, based on your years of experience teaching these students?

I set the stage in this written report with thick, comprehensive descriptions of the socio-cultural environment so others, familiar with such an environment, will readily recognize the authenticity and reality of this report. I wrote about reality, as I saw it, limited by my own socio-cultural perspectives. There is a Person as Instrument Statement in the Appendix.

I was a returning undergraduate college student, after a three year break in my education who then sequentially completed both my bachelor's degree and master's degree without further interruption. I returned to graduate school to pursue a Ph.D. nineteen years after receiving a master's degree. Many of the developmental mathematics students share my experience of returning to post-secondary education after many life experiences. This shared experience may include budgeting time, multi-tasking, creatively making time for personal matters, prioritizing activities, and developing an improved ability to focus on academic challenges.

I began teaching GED and community college mathematics courses nineteen years ago. I began making presentations at national mathematics education conferences six years ago. Attending national mathematics education conferences enabled me to have personal lines of communication and networking with many community college faculty members. We regularly discussed our students, their learning, and their motivation to learn. I could see how my institution and student group were like and unlike other institutions and other student groups.

I believe the host of opportunities for education that we currently experience in the United States is the exception rather than the rule throughout the rest of the world. The educational opportunities in the United States are rare and precious. Most societies do not offer the multiple opportunities for formal education like we have in the United States. While we have this tremendous opportunity we must grasp it. Many of us want to proactively encourage our students to do the same.

CHAPTER 2. REVIEW OF RELEVANT LITERATURE

Introduction

The increased complexities brought on by technology require large student populations to develop skills and knowledge based in mathematics to support technological advances. McCabe and Day (1998) explained that today's workplace is a "high-skill environment designed around technology and people who are technically competent" (p. 14). They identified immigration, poverty, socio-economic status of children, and growing minority populations as pointing to insufficient numbers of well trained workers at a time when American business and industry will need a more skilled work force.

The National Council of Teachers of Mathematics (NCTM) described the needs for citizens to have knowledge of mathematics to facilitate a shift from an industrial society to an information-based society in the *Curriculum and Evaluation Standards for School Mathematics* (1989, p. 9). The NCTM *Standards* (1989) state that it is not consistent with the values of a democratic society that only a few citizens possess the knowledge of mathematics needed to control economic and scientific development. How, then, can we best support this need for a better educated citizenry? We need a better understanding of

students' motivations to learn developmental mathematics. One way is to better understand the motivation of students to take these tasks in hand.

Description of Developmental Mathematics Students

With different ever changing goals, many community college students are likely to pursue their education in a spasmodic manner, enrolling, stopping-out, and re-enrolling, etc. According to Morante, in an interview by Spann and Calderwood (1998), most commuter community college students have little interest in or time for campus life. Lowery and Young (1992), suggested that many developmental students though highly motivated, were not able to direct this motivation to learning mathematics. Many were motivated by family and financial responsibilities, or other interests. McCabe and Day (1998) described some developmental students as never having had "the opportunity or motivation to acquire adequate skills in public school" (p. 29) or as needing "to refresh academic skills they have not used in several years" (p. 29). McCabe and Day (1998) explained that many under-prepared students were from deprived situations and were not able to attend adequate schools, while others just needed to review. Ashworth, in an interview with Hodges, Corkran, and Dochen (1997), explained that one motivation for Texas developmental mathematics students was to prepare to retake the TASP test which they had failed previously either

for having been out of high school for ten years or more, or having been inadequately prepared by under-funded school districts.

Stipek, Salmon, Givvin, and Kazemi (1998), based on their study of fourth through sixth grade students, claimed "students bring a certain level of 'baggage' that can be affected, but perhaps not completely reversed, by instructional practices within the course of a year" (p. 482). Stepek et al. (1998), almost certainly speaking about this baggage, said,

> In this study we provide some evidence of the effects of teachers' practices on students' motivation in regular classroom contexts. The affective climate, which has heretofore been the least studied of the three teacher-practice dimensions, turned out to be the most powerful predictor of students' motivation. A positive affective climate that promoted risk-taking was positively associated with students' mastery orientation, help-seeking, and positive emotions associated with learning fractions (p.483).

Other educators have observed that some developmental mathematics students acquire even more "baggage" by the time they get to their post-secondary programs. Middleton and Spanias (1999) suggested that most students learn to dislike mathematics. In my experience each semester one or more developmental mathematics students described details of their interactions with their middle school mathematics teachers, describing their perceptions of embarrassment or ridicule. Interestingly these perceptions almost always dated back to fifth through ninth grade experiences. Students described teachers who

lacked sensitivity, time, patience, and understanding for students' needs. Usually developmental mathematics instructors have only one semester to affect that "baggage".

Regarding non-traditional students, Preston's (1993) study showed that non-traditional developmental mathematics students benefited more than traditional students from approaches designed to reduce mathematics anxiety. Further, her study indicated that improved affective patterns were associated with higher mathematics achievement. Donahue and Wong (1997) found that non-traditional university students had higher grades and higher work orientation than traditional students, but surprisingly, higher attrition rates. Smith, O'Hear, Baden, Hayden & Gorham, (1996) found that older developmental mathematics students had a higher level of engagement and subsequent achievement.

Motivation Influences Learning

Noting society's need for a well-educated workforce, Alley (1995) stated that developmental educators need to learn as much as possible about motivation and about enhancing motivation in students. Stepek (1988) explained "Motivation is relevant to learning because learning is an active process

requiring conscious and deliberate effort." (p. ix). Motivation, of course, concerns the will and effort necessary to learn challenging mathematics.

The definition of learning in this study was based in the socio-constructivist perspective in which an individual negotiates meaning within her/his social culture. The meaning that an individual constructs depends upon the individual's extant knowledge. That is, the individual constructs new meanings from things they already know together with available learning resources. According to Alexander, Schallert, and Hare (1991), the construction of meaning takes place on the edge of prior knowledge, and includes explicit knowledge, tacit knowledge, and socio-cultural knowledge. Similarly, Prawat and Floden (1994) say, "Constructivist learning theory is based on the now commonplace idea that knowledge is actively constructed by the learner" (p.37).

Learning and the motivation to learn, as discussed in this study, have both cognitive and affective aspects. The NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989) took a stand to include both cognitive learning and positive disposition to learn mathematics. The recommendations concerning affective learning include encouraging students to value mathematics and encouraging students to increase their confidence in their mathematical abilities.

Further connecting cognitive and affective aspects of learning, Wolters and Pintrich (1998) described self-regulated learning by students as the ability to create one's own goals for learning, to develop motivation for the chosen goal, and to use one's cognitive resources to attain the learning goals. They characterized self-regulating learners as being able to overcome obstacles that block their way.

Learning Developmental Mathematics Is Important

In the constructivist model, developmental mathematics is important to provide a conceptual and skills foundation of knowledge with which the learner can construct more elaborate understanding, skills, and knowledge. Also, beyond teaching arithmetic, problem solving, geometry, and algebra, developmental mathematics should provide affective preparation for future learning. According to Mullin (1991) in his popular book *Educating for the 21st Century*, a major challenge faced by educators is helping students understand that mathematics is necessary for the modern world, necessary to many desirable careers, and necessary to a growing number of expanding opportunities for future decades. Implicit in every call for a better-trained workforce is the need to have a workforce with a positive disposition toward learning for future training. As

such, we must better understand students' affective and motivational needs so as not to preclude future learning.

Experts Define Motivation

The literature contains several definitions of motivation that we consider here, along with theories, models, and ideas involving motivation and enhancing motivation to learn. Graham and Weiner (1996) described the study of motivation as no less than "the study of why people think and behave as they do" (p. 63). They continued by explaining,

> In the context of academic achievement, motivational concerns would be addressed if we were to ask, for example, why some students complete tasks despite enormous difficulty, while others give up at the slightest provocation, or why some students set unrealistically high goals for themselves that failure is bound to occur (p. 63).

Developmental mathematics instructors regularly see huge differences in motivation among students. The diversity of motivations among developmental mathematics students seems much greater than among college-level mathematics students generally. Occasionally there are big differences in motivation in a single student in a single semester. Consistent with Graham and Weiner's (1996) observation that some students set unrealistically high goals, developmental

mathematics students commonly overload themselves with too many responsibilities in addition to their developmental mathematics course.

Middleton and Spanias (1999) defined motivation as the, "reasons individuals have for behaving in a given manner in a given situation." (p. 66). They described various theoretical orientations of motivation studies in mathematics education and mentioned representative studies in each orientation, concluding that "research on motivation may not be in its infancy, it has barely reached toddlerhood" (p. 79). Middleton and Spanias (1999) recommended more naturalist studies of motivation by saying,

> (N)aturalistic studies of students engaging in meaningful activity can provide powerful insight into the ways individuals and social groups define motivational constructs, modify these definitions that are based on situational variables, and abstract workable goal structures that inform future engagement (p. 84).

That is, motivation is not an attribute unique to the student nor to the instructor, but is a socially negotiated construct involving both, providing reasons for striving. Many educators agreed with Pintrich and Schunk (1996) that an important goal for teachers was to increase the motivation to learn, thus instructors are active participants in the motivational scheme.

Small and Gluck (1994) described motivation as a measure of the degree to which a person would expend effort to perform or learn. Therefore, Small and Gluck (1994) believed that motivation might be as important a factor as ability in

predicting achievement. Stipek (1988) explained that "students are more likely to be motivated to engage in a task if they understand the goals of the task, the skills it will help them develop, and the potential uses of those skills outside of school" (p. 61).

McLeod (1992) said that clarity is needed in studies of motivation, and called for clearer connections between the study of motivation and research on beliefs, attitudes, and emotions. Moreover, McLeod (1992) described motivation in mathematics learning as needing clarification and connections that fit with cognitive psychology. Important to this study, McLeod (1992) explained that researchers need to distinguish levels of affective responses, such as intense and less intense responses from students. This study contributes to these areas of study in motivation research.

Achievement Motivation Theories

Achievement Goal Theories of Motivation

Some recent studies in motivation to achieve have focused on students' achievement goals (Ames, 1992; Middleton & Midgley, 1997; Middleton & Spanias, 1999; Stipek, 1996). Achievement goals, according to Ryan and Pintrich (1997), could be classified as *task-focused goals*, *extrinsic goals*, and

relative ability goals. Other researchers have classified goals in similar ways for the *task-focused* and *relative ability goals*.

Task-focused goals are identified as goals related to developing understanding and competence. Alternately, *task-focused goals* have been called mastery or learning goals by other researchers (Ames, 1992; Dweck & Leggett, 1988; Middleton & Midgley, 1997; Middleton & Spanias, 1999; Ryan & Pintrich, 1997; Stipek, 1996). Students with primarily learning goal orientations believe that intelligence and ability can be built up incrementally. Students with *task-focused goals* perceive tasks as more important than concern for evaluation of oneself or exterior rewards. Apprehension about criticism of performance was not a problem for a student with *task-focused goals*. *Task-focused goals* are associated with students' attitudes, beliefs, and behaviors that are more likely to be connected to students' successful learning (Ames, 1992; Dweck & Leggett, 1988; Middleton & Midgley, 1997; Middleton & Spanias, 1999; Ryan & Pintrich, 1997; Stipek, 1996). Students who primarily had *task-focused goals* were more likely to connect their own efforts with their successful learning outcomes. Thus, these students were more likely to exert greater effort and, as a consequence were more likely to achieve greater success.

Extrinsic goals relate to rewards, grades, or other external consequences (Ryan & Pintrich, 1997). An important *extrinsic goal* for some developmental

mathematics students, is passing a state-mandated test in order to be able to continue taking college courses. This study took place in a state where passing a state mandated test that included a mathematics component is required for continuation in higher education. Some developmental students in this study saw passing the state test as their only goal related to mathematics learning. Others saw passing the state test and the subsequent college level mathematics course required for their program of study as their primary mathematics goals.

Relative ability goals are related to students' desire to receive good judgments of their ability from others and to appear to be better or smarter than others (Ryan & Pintrich, 1997). Students with *relative ability goal* orientations wanted to please or impress their parents, teachers, or others. These students also sought praise or public recognition, with self-image being more important than accomplishing learning tasks (Middleton & Midgley, 1997). *Relative ability goals* have also been called performance or ego goals (Ames, 1992; Dweck & Leggett, 1988; Middleton & Spanias, 1999; Ryan & Pintrich, 1997; Stipek, 1996). Students that have performance goal orientations believe that abilities are fixed and that each person has only so much ability or intelligence.

Elliot & Harachiewicz (1996) and Middleton & Midgley (1997) studied students' performance-avoidance goals in contrast to performance approach goals. Performance-avoidance goals involved the desire to avoid the risk of

showing lack of ability. Performance approach goals are also called performance, ego, or *relative ability goals* and are described in the paragraph above. Elliot & Harachiewicz (1996) found that performance-avoidance goals are attended by decreased intrinsic motivation. Like *relative ability goals*, performance-avoidance goals related to students' preoccupation with self rather than with the learning task. Middleton & Midgley (1997), however, did not find a connection between either of these types of performance goal orientations and successful achievement perceptions among middle school students in mathematics. The task goals were the strongest predictors of self-efficacy and self regulated learning. Students' performance-avoidance goals should be distinguished from work-avoidance goals. Work-avoidance goals involved avoiding doing work; performance-avoidance goals involved avoiding performance evaluation even when work is done.

Task-focused goals involve instrinsic motivations that concerned students' learning "for its own sake" or as its own reward (Middleton & Spanias, 1999). On the other hand, *relative ability goals*, performance avoidance goals, and *extrinsic goals* involve extrinsic motivations. These goals offer rewards other than knowledge or the simple satisfaction of learning.

Middleton and Midgley (1997) explained that students were not limited to one goal orientation, but they might have several levels of different goal

orientations operating at various times or even at the same time. Indeed, this dissertation study found that students were not limited to one goal orientation, but sometimes described several goal orientations as their motivations for study.

Rinne (1998) could have been describing students who had *task-focused goals* when he said that "most classrooms have one or two students whose enthusiasm for learning is boundless; they seem naturally motivated to learn" (p. 620). He could be describing students who had *relative ability or performance goals* when he said, "A few other students are always agreeable and willing to do whatever their teachers ask of them" (p. 620). Students with primarily *extrinsic goals* fit another of Rinne's (1998) descriptions, "A few more respond nicely to such extrinsic rewards as grades, praise, prizes, and privileges" (p. 620). Rinne's description of students who, "cause teachers to shake their heads and recite the familiar saying 'You can't make them learn if they don't want to learn'" (p. 620) might fit the category of students who exhibit primarily work-avoidant goals. Thus a class potentially contains as many goals as there are students in the class, but these goals tend to cluster into four types in particular.

Intrinsic and Extrinsic Motivation Theories

Though they do not play as large a role in this dissertation study, other motivation theorists have classified motivation into intrinsic and extrinsic categories. For example, Deci, Vallerand, Pelletier, and Ryan (1991) divided motivation into intrinsic and extrinsic motivations with extrinsic motivation, in turn, subdivided into four types: external, introjected, identified, and integrated. Intrinsically motivated behavior was described as being for pleasure, curiosity, or personal interest. The various types of extrinsic motivation might be viewed as a continuum with external on one end and integrated motivation on the other.

According to Pintrich and Schunk (1996), intrinsic motivation was described as activity for its own sake or self-determined activity. In contrast, Pintrich and Schunk (1996) described external extrinsic motivation by example, using students who did not want to learn math, but did so for the praise of teachers or to avoid punishment. According to Deci et al. (1991), learning mathematics "because of its usefulness or instrumentality for the goal of improving math performance and succeeding in future endeavors, rather than because it is interesting" (p.330) was an example of identified extrinsic motivation.

For Csikszentmihalyi (1997) the contrast between intrinsic motivation and extrinsic motivation is the simple difference between "wanting to do it" and "having to do it". Csikszentmihalyi characterized engagement as "flow", an experience of focused effortless action. He described flow as a source that focuses attention and motivates action that might heighten intrinsic motivation. Flow occurs when one's skills are "fully involved in overcoming challenge" (p. 29). Flow involves the complex interplay of challenges and skills, where if the skill level far exceeds the challenge level, the learner is apt to become disinterested and flow will decrease. More to the point of this study, when the challenge level far exceeds the skill level, the learner may become frustrated or anxious and flow will decrease or even cease.

The expressed motivations of the developmental mathematics students in this study are consistent with the theories and constructs presented above, with students describing in their own words the full range of the motivations, including task-focused, extrinsic, relative ability, performance-avoidance, and work-avoidance goal orientations; both extrinsic and intrinsic motivations. A few students even mentioned their appreciation for the challenge and enjoyment of learning new mathematics that may indicate they experienced flow and that it was a motivator to them in learning developmental mathematics.

Efficacy Theories

Self-efficacy theory has to do with the perception of adequate or heightened capabilities to control performance in a restricted domain (Bandura, 1991). The theory extends to the perceived ability to approximately control thought and feelings in self-regulation of goal-directed endeavors (Bandura, 1991). Self-efficacy theory involves a person's beliefs about his/her abilities to achieve a future goal even while allowing that the motivation to do so comes from any of many sources. Bandura (1989) notes that self-efficacy beliefs determine a level of effort and the persistence in motivation. Graham & Weiner, (1996) reported that efficacy beliefs were related to a higher level of specificity in learning than were other motivational theories.

Attribution Theories

Attribution is the student's tendency to assign cause or responsibility for their success or failure in a course of study (Graham & Weiner, 1996; Smith & Price, 1996; Weiner, 1992). There is a common metaphor in the literature of student as scientist, looking to make causal attributions for success or failure (Graham & Weiner, 1996; Weiner, 1992). Social scientists have studied motivation within attribution theory since the 1970's (Moghaddam, 1998;

Weiner, 1992). Weiner's attributional model categorized the causes that students perceived as reasons into dimensions: locus, stability, and controllability (Graham & Weiner, 1996; Smith & Price, 1996; Weiner, 1992).

The locus dimension concerns students' attribution for their success or failure on external, environmental causes, such as difficulty or luck; or on internal, personal causes, such as their own abilities or efforts (Fanelli, 1977; Graham & Weiner, 1996; Smith & Price, 1996; Weiner, 1992). The stability dimension of attribution theory concerns students' attributing their success or failure to stable or unstable factors as they occur over time (Graham & Weiner, 1996; Moghaddam, 1998; Weiner, 1992). The stability property of attribution might be particularly important for students' expectation of improvement in achievement (Weiner, 1992). For example, the student who attributed his or her failure on a test to lack of effort, an unstable property, might be likely to exert more effort in the future. The controllability attribution relates to students' placing causes for success or failure on factors that are either within the control or not within the control of the student (Graham & Weiner, 1996; Moghaddam, 1998; Weiner, 1992).

To illustrate and distinguish the dimensions of attribution the following examples are offered. If a student did not study for a course and eventually failed the course, the student could perceive that failure was caused by internal,

unstable, controllable factors in the locus, stability, and controllability dimensions respectively. By contrast, the student could have believed that she had to work fifty hours each week to survive and help with family responsibilities, resulting in her not studying and leading to her failure, caused by factors that she believed were external, stable, and uncontrollable in their respective attributional dimensions.

Moghaddam (1998) found that causal schemata are strongly influenced by socio-cultural norms. That is, our ideas about causes of our success or failure may be strongly influenced by the customs and values of the social groups to which we belong. Comparing Asian students with other ethnic groups, Hashway, Hammond, & Rogers (1990) found different patterns for perceived controllability between the Asian students and the other ethnic groups.

Learned helplessness is another important and interesting area in the study of attribution theories. Students exhibiting learned helplessness felt that they did not control their academic success and were resigned to failure (Stipek, 1996; Weiner, 1992). The learned helpless might have been generalized failure from past experiences which posed the expectation of future failures.

The ARCS Model for Motivation

Small and Gluck (1994) found that Keller's ARCS model of motivational design provided a useful framework for finding methods to support motivation and enhance learning. Their study concerned student perceptions of the relationships of the four ARCS factors: attention, relevance, confidence, and satisfaction to 35 instructional attributes (Visser & Keller, 1990). Relevance issues concerning whether students realized that they would need mathematics were especially important in this study; relevance strategies that Keller (1987) recommended include:

- State explicitly how the instruction builds on the learner's existing skills.
- Use analogies familiar to the learner from past experience.
- Find out what the learners' interests are and relate them to the instruction.
- State explicitly the present intrinsic value of learning the content, as distinct from its value as a link to future goals.
- State explicitly how the instruction relates to future activities of the learner. (p. 4)

Newby (1991), investigating the motivational instructional strategies used by first year elementary teachers, classified the strategies in terms of the ARCS model. Newby noted that first year teachers often used methods classified as satisfaction-related that were primarily extrinsic in orientation, such as bestowing verbal praise on students, giving them additional attention, or granting them extra privileges. Attention focusing strategies were used less frequently than satisfaction strategies but more often than relevance strategies. Though they

were the third most widely used strategy, relevance strategies had the highest correlation with on-task behaviors. Examples of use of relevance strategies include relating the activity to students' personal interests, or to students' past or future experiences. Newby (1991) claimed that increasing students' motivation to learn by use of relevance strategies might increase students' on-task behaviors. Newby acknowledged that, with limited knowledge of students' interests, the demands on teachers' time and attention could be great in the implementation of the relevance strategies.

Ordering events, Keller (1987) recommended defining the motivation problem, designing strategies, integrating strategies into instruction, and assessing motivational outcomes. He also suggested that in defining motivational challenge, low expectancy of success might be a problem in an algebra class for non-college bound students. Keller supposed these students would probably need confidence strategies before they could perceive the relevance of mathematics to their lives.

Visser and Keller (1990) found the ARCS motivation model was applicable to adult learners in Mozambique, where more socio-cultural value was placed on the well-being of the group, the community, and society than in the United States where greater emphasis is placed on the interests of the individual.

That is, Visser and Keller (1990) found the ARCS model to be effective across cultural boundaries.

Ralph (1998) poses a model that is much like Keller's ARCS motivation model, but with the additional feature of a positive teacher-student relationship in his synthesis. Adding positive teacher-student relationship to a motivation model might be especially important for positively influencing mathematics achievement in developmental mathematics students who frequently describe negative teacher-student relationships from the past.

Influences of Teachers and Their Choices on Motivation to Learn

Teacher behaviors and curriculum choices had important impacts on many students' desires to make initial and persistent efforts in classes (Sass, 1989; Stipek, 1988; Stipek, 1996). Regarding the importance of teachers' curriculum choices, Wolters and Pintrich (1998) say, "activities students participate in can have an important impact on students' motivation and level of self-regulated learning in the classroom" (p.29). Teachers' motivational behavior was found to be at least partially responsible for differences in initiation and persistence in goal-directed behaviors among students according to Wolters and Pintrich (1998). The section that follows describes some of those teacher characteristics and their effects on student motivation.

Enthusiasm

Sass (1989) identified eight teacher characteristics associated with high motivation in his study of 700 college students. Enthusiasm and communicating relevance tied for first place in importance with the students in Sass' study. Rinne (1998) identified that students' enthusiasm for lesson content was strongly influenced by teachers. Finally, Ralph (1998) found that college students, from freshmen through graduate students, highly valued instructors' enthusiasm.

Motivational Embellishments

Teachers can use motivational embellishments which may be as small as a single word of encouragement or as great as the overarching concern of the teacher who considers student motivation in every aspect of instructional design. Motivational embellishment, for my purposes, I will define as any strategy that an educator uses to influence effective achievement motivation in students. Ponticell and Beckett (1997) found that some at-risk high school students were convinced to believe in themselves by supportive teachers. The students perceived that some teachers believed in their abilities, that these teachers designed learning activities aligned with this belief, and that these supportive

"teachers *showed* the students that they confidently expected them to do well" (Ponticell and Beckett, 1997, p. 136).

Stipek believed that "students are more intrinsically motivated to complete tasks that are moderately challenging, novel, and relevant to their own lives than they are to complete tasks that are...perceived to be irrelevant" (Stipek, 1988, p. 73). By contrast, Pentrich and Schunk (1996) recommended that teachers focus on encouraging expectancy and self-competence beliefs that might improve students' achievement rather than worry about increasing students' appreciation for and interest in course material.

Ames (1992) stated that "establishing linkages between the environment, goals, and student motivational outcomes has been very important" (p. 261). She proposed that teachers attempt to establish classroom structures that enhance student motivation by valuing students' effort-based strategies. Ames (1992) claimed that classroom structures could influence students' adoption of particular goals and recommended that entire programs be designed to focus students' attention on task-related effort rather than on social comparison or competition with others. She further suggested that educators choose learning tasks that include variety and diversity in order to increase students' interest. She recommended that students should be able to perceive meaningful reasons for doing tasks, and that tasks should include challenge, interest, and student-

perceived control with a variety of motivational embellishments. In Ames' model, the classroom structures themselves would provide motivational embellishments.

Ames advised that teacher evaluation of students should focus on individual student improvement and should be privately communicated to the student to avoid increasing students' competition for teacher attention. Moreover, it is necessary to communicate to the students that being wrong occasionally is an inescapable part of the learning process that should not threaten motivations. Ames concluded that enhancing students' motivation does not mean merely enhancing students' self-concept regarding their abilities. Rather, enhancing motivation means enhancing the value placed on students' effort and other task-achievement strategies.

Based on similar ideas, Fuchs, Fuchs, Karns, Hamlett, Katzaroff, & Dutka (1997) concluded in their study that a task-focused goal treatment, similar to Ames' recommendations, did enhance effort in children. They found the treatment succeeded with low achieving children but was not successful with children with identified learning disabilities regardless of their efforts. These researchers found that the task-focused treatment showed no effect on intrinsic motivation.

In instances where students exerted effort, but failed nonetheless, Higbee (1996) found that developmental educators could convince students that their past failures might have resulted from the student's lack of background knowledge or lack of effective strategies. Higbee also recommended teaching students meta-cognitive strategies. Schunk (1997) recommended that these learning strategies be integrated into regular instruction. Higbee (1996) explained that developmental educators can offer challenging opportunities for students to enhance self-expectation. Further, Higbee would encourage students' investigation of their own attitudes, values, and beliefs about their motivation, as well as their goals related to higher education. This dissertation study provided an opportunity for students to investigate their attitudes, values, and beliefs concerning motivation along with their goals.

Perceived Relevance

It should be noted that most students in developmental mathematics courses are women. Teachers must become aware that students' beliefs regarding the usefulness of mathematics may divide along gender lines, and these beliefs effect the likelihood that the students will enroll in subsequent mathematics courses (Pedro, Wolleat, Fennema & Becker, 1981; Thorndike-

Christ, 1991; Edkard, 1995). Failing to perceive relevant connections to their personal experience many female students did not believe that mathematics was an important educational outcome. Various studies showed that most correlations between attitudes and performance were higher for females than for males (Bassarear, 1986; Wolters & Pintrich, 1998). According to the students in another study (Sass, 1989), teachers sometimes made relevance and usefulness explicit through explanations and examples. Finally, Bassarear (1986) recommended that studies investigate the influence of attitudes on performance in mathematics by looking at different groups of students.

Elliott (1990), in a developmental mathematics course, however, did not find students' perceived usefulness of mathematics to be a predictor of achievement for females, males, or older students. Likewise, Wolters and Pintrich (1998) found that perceived relevancy was a predictor of cognitive and regulatory strategy, but not a predictor of performance. By contrast, Wolters and Pintrich (1998) found that self-efficacy beliefs were predictors of achievement in mathematics. They suggested that perceived task value might enable students to begin tasks, but that efficacy beliefs helped students persist and overcome obstacles. In the same vein, expectancy-value motivation theorists would classify the relevance aspect as part of the perceived value necessary for motivation, with expectation to succeed the other necessary component.

Frymier and Shulman (1995) found that college students, who reported on their experience with instructors who used explicit relevance behaviors, perceived that the course content was personally relevant. These relevancy behaviors helped to connect the course content with the students' values or goals. Pintrich and Schunk (1996) recommended that teachers discuss the importance and utility value of schoolwork with students. One of the reasons that teachers did not discuss this value extensively with their students might be that they did not receive direct instruction in the utility value of learning themselves. Weaver and Cottrell (1988), beyond teaching content, suggested that instructors tell students how the course will increase their skills, add to their knowledge, and be useful to them. Students were found to be more likely to listen and respond if they believed there was personal gain in the learning experience, for example realizing the relationship of their values, goals, behaviors, and relationships with others to the course content.

In a report titled *Crossroads in Mathematics: Standards for Introductory College Mathematics Before Calculus*, the American Mathematical Association of Two-Year Colleges, AMATYC, (1995) recommended that students should study mathematics that was meaningful and relevant to them. The AMATYC *(1995) Standards* also stated that one benchmark for educational pedagogy was helping students connect their course work with other life experiences, that is,

faculty and producers of instructional materials both have a responsibility to make mathematics relevant and meaningful to students. Nunes, Schliemann, and Carraher (1993) distinguish informal and formal mathematics as street mathematics and school mathematics, respectively. They recommend integration of street mathematics and school mathematics by introduction of relevant problems. Other researchers agree: Husman (1997) suggested asking students to imagine how they might use the subject, while Keller (1987) recommended that instructors "ask learners to relate the instruction to their own future goals" (p.4).

Busald (1997) increased students' perceptions of the relevance of statistics by involving his class in a study of a specific game of the Texas lottery. Students' interest and involvement skyrocketed when students discovered the misleading claims being made about the probabilities for the expected winnings.

Sanbormatsu, Shavitt, and Sherman (1991) believed that students' perceptions of personal relevance increased the likelihood that incoming information would be integrated and organized. Unfortunately, teachers cannot foresee every future mathematical need of his or her student. For example, an acquaintance recounted that she might not have lost her business if she had learned enough mathematics to successfully manage the business.

Mullin (1991) argues that there is a social relevance to learning mathematics. According to Mullin, a major challenge for educators is helping

students and parents understand that, as the language of the natural and social sciences, mathematics is necessary to understand the modern world. Modern business practices depend upon technological precision in analytical reasoning, and it is increasingly more important to be able to use technologies in the humanities.

A Dedicated Human Relationship

Visser and Keller (1990) commented that a dedicated human relationship was a necessary, though not sufficient, prerequisite to influence the motivation of another person. Similarly, Frymier and Shulman (1995) concluded that teacher immediacy behaviors, the perception of closeness that the student feels with the teacher, may be necessary for the students to perceive the importance of mathematical instruction.

Brown (1995) identified "instructor concern" as caring if the student passed or failed, encouraging students to stay in school, encouraging students to do a good job, helping students outside of class, and valuing conversations with students outside of class. She found these characteristics to be particularly important to developmental students. I am confident that Ralph (1998) is saying much the same when he talks about "relationship" in his discussion of college students. He explained that a positive teacher-student relationship included

respect, support and warmth, and he described students' need for affiliation and belonging as being connected with the importance of the student-teacher relationship. Ralph even went so far as to say, "the socio-emotional domain is as equally important as the cognitive and academic components" (p.37).

Teacher immediacy, the students' perception of personal relationship with the teacher, has been found to influence motivation and learning in college students (Christensen & Menzel, 1998; Christophel, 1990; Frymier & Houser, 1997; Frymier & Shulman, 1995). Christensen & Menzel (1998), studying students at a small liberal arts college, found that teacher immediacy was related to students' perceived cognitive learning, affective learning, and motivation. Ferrari and Mahalingam (1998) claimed caring teachers helped orient students by treating them as developing persons in the process of constructing cognitive tools to reach goals that they value. Noddings (1997) discussed the value of a caring, trusting relationship between student and teacher, and Glasser (1990) found that students would work harder for teachers that they liked than they would for teachers that they disliked. The overarching principle of all of these studies is a teacher's genuine concern for his or her students and what impact that has on learning outcomes.

Student Reports Concerning Motivation

Ponticell and Beckett (1997) found that at-risk high school students valued their relationships to teachers and their relationships with other students. Further, they placed importance in trust and respect between teachers and students. Brown (1995) reported that developmental students valued instructor helpfulness, caring, and accessibility. Her study also found that students believed it was valuable to have a sense of "belongingness" and that their relationships to teachers helped them develop this perception of belonging. Ralph (1998) found, among other things, that college students from all levels described effective teachers as friendly, enthusiastic, and encouraging.

Smith and Price (1996) reported that developmental students believed they had not been required to work hard enough in high school. External factors were reported by 83.8% of the students as contributing to their lack of success in high school. Smith and Price suggested attributional retraining might improve student ownership of learning and subsequently their motivation to learn in developmental courses.

Higbee (1996) noted that factors that influence student motivation to do homework and study included grades, future goals, parents' expectations, sense of accomplishment, and personal relationships. The list of factors tends to be

weighted toward extrinsic motivations, with only "sense of accomplishment" relating to intrinsic motivation.

Conclusion

Weiner (1991) concluded his survey of major metaphorical themes in the history of motivation theories with a reminder that motivation has a multifaceted nature, and is a complex and largely unexplored field of research. The purpose of this dissertation is to investigate and describe motivation as it is related to affective issues in developmental mathematics students.

CHAPTER 3. PROCEDURES FOR DATA GENERATION AND ANALYSIS

A naturalistic paradigm was applied to investigate students' perceptions of their motivations and the things which affect their motivation. The naturalistic paradigm was most appropriate in order to concentrate, to the fullest extent possible, on capturing the informants' own beliefs and experiences as revealed by their words, thoughts, and deeds. This form of research places reduced emphasis on the role and perceptions of the researcher. The purpose of naturalistic inquiry according to Erlandson, Harris, Skipper, and Allen (1993) is not to form "generalizations that are statements free from time and context" (p. 45), but instead "to develop shared constructions that illuminate a particular context and provide working hypotheses for the investigation of others" (p. 45).

Data Collection

The primary participants were elementary algebra students at a community college who, for the most part, were taught by instructors who were not the researcher. Some of the participants were asked to complete learning journals by supplying honest responses as prompted by stems of open-ended questions about

their motivation, goals, attitudes, beliefs, emotions, and study strategies during the semester. In addition, the students ranked a list of goals and a list of course focus ideas. See the student learning journal sample and the blank student learning journal in the Appendix.

I desired participation from instructors with a variety of viewpoints. Instructors decided if grades or credit would be assigned for completing the student learning journal, or even if the student learning journal was optional or required. In order to encourage participation and promote diversity of instructional styles, few constraints were placed on the instructors regarding the ways in which they distributed and collected the journals.

Refinements to the student learning journal model were made after review by knowledgeable colleagues and advisors and after study of the pertinent literature. I wanted to be sure that the student learning journals did not become surveys to support current research. I wanted the student learning journals to continue to encourage descriptive, sincere, honest, in depth responses that could be reflected upon and added to during the semester. If students did not sign the passive consent form, I received journals from their instructors at the end of the semester. I asked instructors to remove the student name page and replace it with the page I provided for the student course grade, final exam grade, pretest grade, and any additional information the instructor chose to provide. Most

instructors did not provide additional information other than grades about students, but one or two did.

In interviews, I asked students and faculty members to tell me about their perceptions of motivation to learn in developmental mathematics students. I audio-taped each interview, which I conducted using emergent, qualitative interview techniques, intended to allow the interviewee to express his or her ideas freely, without being "guided" by the interviewer. I asked follow-up questions only on ideas that the participant brought up in the interview, and refrained from topics of interest to me.

Member checking is verification that the researchers' understanding is consistent with the meaning intended by the participant. According to Erlandson et al. (1993) member checking is important in naturalistic inquiry because the research is a construction of understanding within the context of the study between the participant and the researcher. Member checking involved three levels of verification with participants, whenever possible. The levels are verification of meaning during an interview, verification after an interview when a summary of the interview was provided to the participant for review and checking, and verification by submission of a report to the participant. For the reasons above, I member checked during the interviews, and afterwards whenever the participant would respond.

I transcribed interviews from audio-tapes. The interviews were then divided into "units of meaning", usually a phrase or sentence in length, the general meaning of which was represented by a code, a brief word or phrase. See the list of code words or phrases and their meanings in the Appendix. The transcribed interviews were unitized and coded by hand during the first semester. In subsequent semesters, I used NUD*IST software to code and analyze units of meaning and analyze emerging patterns of meaning.

Analysis Procedures

I analyzed student and faculty interviews and student learning journal documents using a constant comparative method to find patterns and themes, and to uncover the relationships between them. A unit of meaning was conceptualized as a small idea that could stand alone and unitized data is data in which the small pieces have been identified. I unitized data from interviews and student learning journals by dividing the data into segments or units related to one idea. A code or label was conceptualized as a general descriptor of the main idea. Sometimes the codes or labels were the same as concepts or ideas in some motivation theories or models. I coded the data by applying descriptive codes or

labels that had emerged from the interviews and journals to the units of data whenever one or more of the codes was appropriate.

A unit for coding could be a short phrase, a sentence, or a paragraph. The code or label assigned to a unit was a descriptive word or idea that might become an emerging theme or part of a theme as analysis continued. Themes and patterns emerged from groups of coded data. The emergence of themes was a continuous process that was ongoing during and after data generation. I organized and reorganized the themes, constantly looking back at the data for confirmation and listening to the tapes repeatedly. Erlandson et al. (1993) described this interactive process and explained, "This principle of interaction between data collection and analysis is one of the major features that distinguishes naturalistic research from traditional research" (p. 114).

Quality criteria considerations

Trustworthiness

Trustworthiness and *authenticity* are important quality criteria in naturalistic inquiry. First, trustworthiness has to do with the quality of the methods used in the study. Trustworthiness, or truth value, of a study's results depends on credibility, transferability, and confirmability, according to Erlandson et al. (1993).

Credibility

Credibility is how the study communicates the meaningfulness of the constructions of the informants or participants. The constructions of the participants, though, are really co-constructions with the researcher, and the study should communicate the meanings of the participants in their context. Credibility depends on prolonged engagement, persistent observation, triangulation, peer debriefing, member checking, and the reflexive journal (Erlandson et al., 1993).

Continuing for more than one year the prolonged engagement of this study resulted in saturation, a phenomenon where later responses merely mirrored earlier one. After saturation occurred I ceased collecting data, but

noted that new students continued to communicate the same themes, and no new themes or ideas were found.

Persistent observation involved regular contact with both developmental mathematics students and developmental mathematics faculty members. I regularly heard student and faculty member conversations concerning student determination and effort. During this investigation, I made several presentations concerning student motivation in mathematics learning to developmental educators and high school teachers and received feedback from them. My persistent observation confirmed the appropriateness of my labels for units of data and determination of emerging themes. The persistent observation, though a painstaking aspect of this form of research, provided the depth and richness to the research study that would have been impossible otherwise.

Another support for credibility is triangulation (Erlandson, et al., 1993). Triangulation in naturalistic inquiry can involve multiple sources, methods, investigators, or theories. Using multiple sources and methods, I used interviews of students and faculty members (different sources), e-mail communication with faculty members, and document analysis (different methods) of learning journals from day, evening, and summer students from different campuses (different sources) for triangulation.

I met with other colleagues and researchers in university peer-debriefing groups throughout the study. There is an example of the peer-debriefing group minutes in the Appendix. Group members discussed each other's research projects, shared ideas, gave advice, and read drafts. We discussed decisions, data collection, coding, analysis, and the write-up phases of our studies. According to Erlandson, Harris, Skipper, and Allen (1993),

> Peer debriefing helps build credibility by allowing a peer who is a professional outside the context and who has some general understanding of the study to analyze material, test working hypotheses and emerging designs, and listen to the researcher's ideas and concerns (p. 140).

During the study I participated in three different peer-debriefing groups, composed of researchers doing naturalistic inquiries. I participated in each of these groups at different times but for a few months I did not have a peer-debriefing group. The first two peer-debriefing groups disbanded after several months of discussions of each participant's research. Each peer-debriefing group had contributed to the continuation and the overall quality of the research study.

Member checking, recall, is believed to support credibility in naturalistic inquiry studies. I interviewed five developmental mathematics faculty members about their perceptions of motivation in developmental mathematics students for this study. I asked them to tell me about their perceptions of motivation in developmental mathematics students. There is an interview transcription sample in the Appendix. Employing the first form of member checking, I repeatedly

asked participants for clarifications of my understanding of their meanings. After the interviews were transcribed from the tape recordings of the interviews, I employed the second form of member checking when I wrote a summary of the main ideas as I understood them and asked the participants to respond to them. There is an example of member checking in the Appendix. It should be noted that one of these instructors responded by e-mail.

I did a follow-up interview with the faculty members, whenever possible, in which I asked for clarifications and further explanations of their perceptions of motivation in developmental mathematics students, using ideas from the summary of the first interview. The third form of member checking for the faculty members was giving the respondents a copy of the case study for clarifications of meanings whenever possible. The students did not have time for second and third forms of member checking, although I was able to member check with one student later in further conversations. I incorporated these clarifications into the study. The intention of the member checking process is to ensure that the meaning that comes through to the reader from each participant to be the meaning that the participant intended to convey.

I kept an ongoing reflexive journal throughout the entire dissertation study. There is an example of the reflexive journal in the Appendix. In the reflexive journal, I noted decisions, reasons for decisions, personal ideas,

activities, and schedules of activities related to the study. In accordance with recommendations of Erlandson et al. (1993), the reflexive journal provided an audit trail to support credibility, transferability, dependability, and confirmability of the study. The reflexive journal remains the extant property of the researcher.

Transferabilty

Transferability concerns whether findings can be applied to other contexts or other subjects. The naturalistic researcher understands that all research is limited by its particular context. The knowledgeable reader must decide if there is a basis for transferring meaning discovered in one context to another context. The researcher has the responsibility to describe the context of the research, and research findings in sufficient detail that the informed reader can make transferability decisions. Transferability is supported by "thick description", purposive sampling, and the reflexive journal (Erlandson, et al., 1993).

Confirmability

Confirmability is a quality that relates to ensuring that the findings can be tracked to appropriate sources. The reflexive journal is evidence of confirmability according, to Erlandson, et al. (1993). Though the identify of the participants in the student learning journals is unknown to me, it can be easily

confirmed that these learning journals were done by the hand of learners with many different concerns and cognitive styles.

Authenticity

Authenticity, the other quality criteria consideration, has to do with the meaningfulness and usefulness of the study. Authenticity means that the study accurately portrays the meaning intended by the participants and that the study is useful to the stakeholders. Authenticity has the criteria of fairness, ontological authenticity, educative authenticity, catalytic authenticity, and tactical authenticity (Manning, 1997). Fairness is the authenticity criterion that the researcher controls. I interpreted the meanings intended by students and faculty fairly and without seeking to promote my views or the views of others. I intentionally sought interviews and understandings from both full-time and adjunct faculty members from a variety of backgrounds different from my own. I sought understanding by using interviews from students different from myself who were referred to me by the non-course based remediation coordinators from two campuses. I interviewed all the students who were referred to me, except one who would not respond to my request for an interview. The university departmental research committee restricted me from requiring the student learning journals in my classes. In order to collect a diverse sample, therefore, I sampled understandings from developmental mathematics students at several

different campuses, using student learning journals collected from the classes of seven other instructors. Drawing participants and instructors from all points of the calendar and clock, the courses taught by the other instructors were taught in any of the fall, spring, and summer semesters and also were taught in the day or the evening.

Constant Comparative Coding

In constant comparative analysis the ultimate instrument of analysis is the researcher, using knowledge and informed judgement. Constant comparative coding began with the first interview and continued throughout the study. Patterns and themes that emerged from the data were identified and coded, and in-coming responses were regularly compared with earlier responses. Some codes diminished in importance as investigation continued, while others became more important as they were repeated, explained, and clarified by more informants. The latest codes are listed in the Appendix along with the last grouping of codes connected into themes and patterns. The data analysis was characterized by continuous reassessment of earlier outcomes in light of later outcomes. For instance, if a new code emerged late in the study I returned to the earlier journals and interviews to be sure that the ideas were there, but had not been coded yet in a manner consistent with the later code.

Purposive Sample

Purposive sampling involves selecting particular participants who have the characteristics or knowledge sought in the descriptive study. Since this study sought perspectives on motivation in developmental mathematics students, a variety of developmental mathematics students and instructors of such students participated. According to Erlandson et al. (1993), thick and rich description with purposive sampling is the foundation of transferability. Transferability involves the knowledgeable reader's decision, not the researcher's assertion, concerning whether ideas, working hypotheses, findings, or theories presented in a research study are applicable to the knowledgeable reader's context. Descriptions or case studies of student and faculty member participants support the thick, rich description of the setting and students in this dissertation study to make transferability decisions. The decision to transfer ideas made by a knowledgeable reader is in contrast to the generalizability that is the goal in many other forms of research.

I sought participants who had diverse knowledge of motivation in developmental mathematics students. I purposely sought participants among students and faculty members who had knowledge of the complexities of

motivation in developmental mathematics students. Students wrote in learning journals during a specific semester, while others participated in interviews. I interviewed participants and investigated their understandings using the recommended techniques of emergent interviewing and member checking.

Eight instructors, including me, asked developmental mathematics students on several campuses to respond to stems concerning their motivations, attitudes, beliefs, goals, and study habits in a learning journal. There is a sample from a student learning journal and a model blank student learning journal in the Appendix. I provided blank learning journals to seven other elementary algebra instructors, who had volunteered to distribute, collect, and read the journals from their students during a given semester. During the process the journals were collected, read, and redistributed to students several times each semester. Students were allowed to review and add to their comments, a rudimentary member check, before turning them at the end of the semester. The instructors removed the identity of the participants from the journals and sent the journals to me for analysis. The instructors included both full-time faculty and adjunct faculty employed at several different campuses. Most instructors collected data for only one semester, but some collected data for more than one semester. The data collection of student learning journals took place over sixteen months, including two fall semesters, one spring semester, and one summer semester.

Non-course based mathematics remediation coordinators from any of the campuses of the community college referred developmental students to me for interviews. The coordinators chose students who they perceived to be articulate and who might benefit from reflection on their motivations from among students required to be in non-course based remediation because they had not completed their mathematics course for the semester. One student who was referred to me did not respond. I had to communicate with one student for six weeks before I was able to arrange a successful meeting for an interview.

Student participants

Two of the students I interviewed were African American women. One explained that her past motivations were very different from her present motivations. She attributed the change to maturity, her son growing older, and her patient elementary algebra teacher who would explain things until everyone understood.

The majority of the developmental mathematics students in this community college were female. They ranged in age from eighteen to fifty-five. The students offered vivid descriptions of their personal motivations and their varied mathematics backgrounds. Many students wrote or told me they disliked studying mathematics. Some of them had dropped out of high school and later

received GED certificates. Some of them had been unsuccessful learning high school algebra. Others had some success learning high school algebra, but had many knowledge gaps in their foundation of understanding mathematics and problem solving. Some students did not take high school algebra while they were in high school. Some students had been out of high school for years and needed to refresh their mathematics knowledge. Many developmental mathematics students worked at full time jobs. Some were married, some were single, and others were single parents.

I related to many of these students because I recognized that some subject areas were difficult for me to learn in the same manner as mathematics was difficult for some of them to learn. There is a Person as Instrument Statement in the Appendix. In my study of developmental mathematics students' motivations for learning, my experience indicated that the student population was very diverse in age, maturity, ethnic background, educational preparation, economic situations, life experiences, life circumstances, career goals, personal goals, and learning needs, as well as their motivations for learning mathematics. Among the diverse student population, there were some themes and patterns of student motivation that aligned, to some extent, with some of the current theories and models of motivation to learn while others did not.

The names contained herein are fictitious, and have no connection to any real student or faculty member. The students who were listed as low-achievers made D's, F's, and occasionally W's in their developmental mathematics course.

Faculty participants

For the faculty interviews I asked for participation from experienced developmental mathematics instructors who I believed might have different perspectives than my own. One faculty informant, whose pseudonym was Mac, had many years of experience in teaching developmental mathematics although his Ph.D. was not in mathematics nor education. He had served as developmental mathematics department head at a large campus of a community college and had a style of teaching different from mine. Another faculty informant, whose pseudonym was Helya, was very popular with developmental mathematics students. Students had told me they liked to learn in her class. She grew up in a Middle Eastern culture. Many faculty members thought the third informant, whose pseudonym was Mary, had a great deal of knowledge of teaching developmental mathematics students. Mary was Hispanic, an under-represented minority group in mathematics education. Helya and Mary were both experienced adjunct faculty members who taught three developmental mathematics courses each semester. The fourth faculty member informant,

whose pseudonym was Craig, was an award-winning professor with years of experience teaching developmental mathematics and college level mathematics at several community colleges. He had also served as a mathematics department head. The fifth faculty member, whose pseudonym was Margaret, was a full-time professor with a Ph.D. in mathematics. Like Craig, she had taught both developmental mathematics and college level mathematics at several other colleges. Mac, Craig, and Margaret were full-time faculty members. These participants presented very different backgrounds with diverse experiences. I expected to hear stories from different perspectives on motivation in learning developmental mathematics.

Setting

The setting for this study was a large urban and suburban community college in the southwestern part of the United States. This region is popular with international students, students from across the United States, students from around the state, and local area students. It is common to have as many as three international students in a class. In the course of the study I had students in developmental mathematics courses from Bosnia, Hungary, Vietnam, Nigeria, Kenya, Thailand, and Mexico. The English language presented a challenge for some of these international students.

The college was divided into six separate primary campuses across the city, with two of the primary campus sites located in suburban areas. For the convenience of its public the college had many smaller teaching sites, but the student and faculty participants in this study attended the primary urban or suburban campuses rather than any of the smaller teaching sites. Adjunct faculty members taught more than 60% of the developmental mathematics courses. High proportions of adjunct faculty members teaching developmental mathematics classes was not unusual for community colleges. It is not surprising, then, that citizens reported that the quality of developmental mathematics instruction at the community college varied greatly. The students, though, wrote more positive than negative comments about their teachers in the student learning journals.

The class size limit for elementary algebra at this community college was twenty-five. Classes were purposely kept small according to the program design. Students were placed in the course subsequent to a mandated assessment and placement procedure, with most seeing an advisor before placement.

The majority of the data for this study was collected at a primary campus located close to new apartment complexes, information technology companies, and other high tech companies. The campus offered more student activities than most other campuses at the college; however, there were very few school-related

social events or extra-curricular activities. Many students seemed reluctant to attend extra-curricular activities unless the student was directly connected with the group sponsoring the event. The college did not offer any intercollegiate athletics for its students. There were no college dormitories or other campus housing at any of the campuses. There were several picnic tables under trees and a small student lounge on campus for informal activities. The student lounge was usually crowded except on Friday afternoons and weekends. Classes were scheduled between 7:15 a.m. and 9:45 p.m. on weekdays, with some weekend classes.

Most students spent only the minimum required time on campus. The majority of students came for classes and left immediately after classes. Many worked at full-time jobs and spent their time in social relationships with people that they did not meet at college. Students often felt very little, if any, connection with the college until they attended classes for several semesters.

CHAPTER 4. CASE STUDIES AND DESCRIPTIONS

The lengthy descriptions are combinations of first-person quotations, taken directly from the student learning journals, that described characteristics and perceptions of the student participants. Six themes and patterns emerged to categorize the ideas of the students in these descriptions. These themes were attitudes, emotions, beliefs, goals, other circumstances, and teacher's impact. These six themes were important in the students' descriptions of their motivations to learn developmental mathematics. These categories were similar to most of the categories in the Findings section.

The first person descriptions from the student learning journals allow the reader to experience the depth and breadth of the perceptions of the low-achieving students, who did not finish the course with an A, B, or C, in contrast to the perceptions of the other students, who did pass and receive credit for the course with a grade of A, B, or C. Sometimes ideas the students presented conflicted with their earlier stated views. Further, though they attended the same course, some students' ideas conflicted with other students' ideas.

The two descriptions of the perceptions of low-achieving and other students are followed by the short case studies of three student participants. The three short case studies describe the perceptions of the students who did not finish their mathematics courses successfully in that particular semester, to more

fully portray perceptions of lower achieving students who may not have written as thoroughly in or turned in student learning journals as did the other students. The three short case studies represent portrayals of students who have not yet passed the mathematics section of the TASP test and document their ideas about their motivation to learn mathematics. As throughout this study, student names are pseudonyms. The interview data generally supported the journal data provided by low-achieving student learning journals, although low achieving students were less likely to turn in journals for research and less likely to finish the course.

Following the student case studies are five case studies of experienced faculty members who describe their perceptions of the motivation to learn among their developmental mathematics students. The descriptions by the faculty members generally support the ideas expressed by the students and deepen the thick, rich description of the setting and students.

Part I: Students Themes

Typical perceptions of under-achieving developmental mathematics students

Background

> Ever since I was very young, I've always had a problem with learning math material. At a really young age about junior high school was really when I lost interest in math. During my elementary school and middle school years,

I had teachers that weren't really good. Now I am more confident because I understand and accept math more.

Attitudes

I don't really like to practice math. And my passion for homework is none. My attitude about learning math is Lazy—that's why I'm failing now. My attitude for math needs to change because right now I don't have the best attitude for math and I need to get a better one. I hate math so I have it stuck in my mind and I don't always try my hardest. But when I am on a roll and making good grades then I kind of like it.

I go to get help now until I understand. I guess now I'm really, really trying to understand this. I have more patience now with math, and now at times I enjoy it.

I know that I can learn anything that I put my mind to.

Attitude of Confidence

I am not confident in learning math because it's hard to stay focused.

It's a must that I overcome my math fears. Sometimes I don't feel so confident because I don't understand math. Or I get discouraged whenever I get a failing grade.

I feel a lot better about myself when I understand it and can do the problems.

Emotions

I start to feel I do all the problems wrong. I get confused then I get frustrated. That's when I feel like giving up. I feel anxiety, I feel that I don't have good math skills.

Some of my emotions about learning math include sadness, fear, and anger. I find myself frustrated and wanting to give up. When I think I have an answer right, it's wrong. I think I started crying during the last 3 tests because for some reason the material left my head. Even though I was just studying it and had it down.

Fear! I get deep seeded anxiety because when I was in high school I skipped class so I failed all my algebra—I know I am capable of getting over my fears. Hopefully I can just try my best. I must study, ask questions and do homework.

I am fearful of math but, hopefully will change my attitude and get over my fears. Everyone needs math I would like to master basic algebra. I still hate word problems!! But little by little I'm starting to feel more comfortable. I feel frustration with the unknown methods. I do feel pleased with myself when I understand the problem.

I sometimes get frustrated because I have a hard time learning math. But I make the best of it and try hard. Practice makes perfect. My emotions towards math are not very good. I feel very intimidated by math, and sometimes fear it.

Ever since I was small, I have hated taking math. It frustrates me because I usually do so well on homework but when I go to take a test I usually fail. It wasn't until recently that I realized how useful it is and how much I really need to know of it.

Math has always been a downfall for me and I accept that and don't care if I do well in math (math underachiever). I also think I'm lazy when it comes to math. It starts feeling so overwhelming right before we take tests. I start to feel like everything is becoming mumbo jumbo…I even forget how to add!!!!

I feel confusion, frustration and when you finally figure out what you are working on, JOY

Beliefs

It's a necessary evil; some of it is unnecessary. Some math is important. If you can't add, subtract, multiply or divide well that means you need help. Almost every job requires that. But some of this other junk, means nothing.

Some of my beliefs about learning mathematics include it is a complex subject that has always given me problems sense the 2nd grade. I seem to

believe that math really is not that important. Well of course everyone needs to know the basics to get by in life, but other than that unless your major is mathematics most of what you learn is forgotten!

I like to learn math, I really like it now because I understand it more now. But I don't understand why we have to learn some things that we will never use. I am not confident in learning math because I tend to forget the more difficult math procedures as soon as I don't have to do them anymore. When I'm away from school I've never, ever had to use any of the difficult mathematics that I learn in school. I will never use this in real life. A typical attitude that most students have.

I personally have a very hard time with math.

You have to want to learn math and understand it a little to do at least half right. You have to be clear and listen very well while your learning it, especially algebra. I feel involved in learning in math class when I and other class mates work together to solve a problem

Belief concerning efficacy

Now that I know I can do it by working hard I really want to try. If I know I can do something I want to get better at it.

Goals

Extrinsic goals

My major doesn't really require any mathematics except college algebra. My motivations for mathematics would be the requirements for my particular degree plan.

I actually only have one college algebra math class that I have to take. I wouldn't take algebra if I didn't have to. I didn't do so hot on my TASP. I hadn't taken math in 10 years. I'm still not crazy about it.

Learning math depends on the person. I think everyone should know the basics. I just don't understand when me, personally am going to use algebra or geometry…I haven't yet and I have yet to realize when I will except for in school. I need to pass the TASP test.

Now, I am glad I am taking these classes so that I can strengthen my math skills. I want to learn how to solve work problems and such, but all the algebra stuff is not as important. I have to learn math for my major.

Learn how to work through problems, and how to work them out, and learn the formulas. Also to help study for the TASP test. I need it for my degree. It would feel good and be empowering to finally get it.

I need mathematics for my degree plan. If I didn't need mathematics for my degree plan I would not even think about any type of math. Math does not motivate me at all, unless I just have to do it.

Task-focused goals mixed with extrinsic goals

(Sometimes) I want to reach my goal which is to be able to understand mathematics better. I want to be able to solve problems without any troubles. I would like to improve my math skills. I hope to have a career in health care and that particular profession requires MATH SKILL! When I want to learn math I remind myself how crappy it feels to be clueless in class or on a test.

Other circumstances

I find it difficult to spend more time on this subject because I am taking 3 other classes that devote a lot of my attention; many factors hinder me from doing as well as I would like.

Other classes which require a ton of attention for me to do well, many papers, I have to write for speech, Eng. II, and humanities.

My time is taken by other classes and homework in those courses. Work takes my time. I feel that I can't concentrate unless all the other things in my life are taken care of (too many things on my mind; I can't concentrate unless I take care of business.).

I am very busy, I work 2 jobs, go to school. To be quite honest I like to have some down time. Sometimes that means I don't put enough energy into school, mostly math. Because I have a mental block towards it. Next semester I'm going to try and work less, become more of a student.

Sometimes I just space out when I should be doing homework. Family problems, my mom's health, many outside responsibilities that become extremely overwhelming take my time. I want my professor to know that she is a good teacher and seems to genuinely care about students, but has to understand that some students have other subjects to deal with as well as family issues. And the reason for why, I haven't done as well this semester has nothing to do with me not trying or doing by best. Things just happen in life.

My time is taken by my 3 year old son; I feel exhaustion.

Teacher's impact

I want my professor to know that it is not her that makes me hate math. She is a great teacher and knows a lot about math.

I also get frustrated with teachers who appear angry when you don't understand. I feel frustration from confusing ways of teaching from some teachers who are hostile when you don't understand.

Only the best teachers can teach it! I believe that a more relaxed and slow paced environment is the best way to teach all forms of mathematics as well, as an instructor with an ability to teach without getting frustrated.

A good teacher and a lot of hard work; you will do fine.

Typical perceptions of other developmental mathematics students

Background

I take math because I have to, but secretly I like it. I like doing math homework but I hate tests. I can get perfects all semester on homework, take one test and bomb it. Maybe it's anxiety. Anyhow, I take math because it's required, but I'm glad I'm taking math because I never really learned it properly.

It is required. It will make me feel more intelligent and give me self-confidence and make me feel I've accomplished something.

Attitudes

I feel good and confident about what I am doing, at the moment and I am ready and excited to learn more. But that rarely ever happens due to the fact that I hardly enjoy what I am doing to feel good and confident about it.

Leaning math is either enjoyable or not if you make it. Learning anything can be as fun as you make it or as boring as you make it.

I don't hate math any more and I look at it in a different light so that I can handle the subject. I am doing better in math than I did when I first started college. I don't have as negative of attitude toward math as I did when I first started college. I feel happy with math when I do well on the homework.

For me to do my best learning, especially in math, I must study during the day or early in the evening. This usually conflicts with playing basketball or going to the movies, but I feel content to sacrifice because work takes my other evenings and I have no choice. Only responsibilities keep me from studying in the evening. I also have to keep assuring myself over and over until I take the test.

If I try, I can to anything. One day I could rule the entire world. Since I am studying and understanding math I feel more confident. Not only in class but test taking and applying it to life.

I have an interest in how to work problems. I like the feeling of accomplishment after completion. Mathematics is fun, when I understand.

Emotions

My emotions include apprehension, anxiety, growing confidence, excitement at putting the pieces together; Paranoia, sheer terror, fear of failure (again!). Knowing I must succeed this time in order to move on with my education.

I feel fear of failure, of feeling stupid because I don't understand. I feel elation when I do understand and when I can figure something out on my

own. I feel a sort of bull-headedness because I think, sometimes, I can't learn it. I feel frustration when it keeps going over my head.

I feel fear. Math has a way of conquering me sometimes. All through middle school and high school I recall spending hours studying for math tests and never making a passing grade. It became very discouraging. My lack of self-confidence in math is big. I check my work constantly because even basic math can be frightening for me.

Hostility. Confusion. I know I need to learn math, but past experiences have been horrid. I skimmed through high school with low C's and after a few years off! Am anxious and nervous about learning.

My emotions include feeling bad and loosing my self-confidence whenever I don't understand a problem or topic in math. It makes me so weak and mad, and if I finally solve that problem or topic, I feel like I have just overcome a very big obstacle in my life.

Sometimes I feel Confusion, Rage, Insanity, Confidence, and sometimes happiness. Frequently I feel anxiety; Frustration joy and hope-when I understand something

I really am intimidated by math especially the basic arithmetic type yet the algebra I find is almost 'fun' or at least I perceive the answers better. I don't know why that is.

I have trouble with some problems, to be specific word problems! I hate them! I can never figure out what some are asking.

My first emotion is scared to death, but as I go on I see that it is not as hard as I thought it was. As I keep going and learn more I tend to sort of look forward to class. I'm still math phobic and I get frustrated when I can't grasp a basic concept or have morphed one concept with another and continue to get incorrect answers

Now that I can appreciate problem-solving skills, I tend to feel overwhelmed and at times incapable of performing them; I panic, especially problems involving lots of data. As soon as I see a lot of numbers, variables, and words (word problems) I immediately shut down for a split second, as if I lost my breath. Bizarre? Maybe. It's like my

brain and body need time to catch up with the spin I set into motion after reading some math problems. I don't feel involved in learning in math class –even though I ask questions of my instructor and follow along with her and the class—feeling involved still eludes me. I feel like a watcher, an outsider still.

Learning math is somewhat enjoyable when I feel that there is a smooth and consistent flow in the "absorption" process of what I am learning.

Beliefs

Sometimes I feel negative because at times it seems to me that there is no need for the material in which I am studying at the moment. If I do start to feel that way, it makes me feel like studying this material is a complete waste of my time.

I know that once I have learned it, it will surely help me in my future activities both in personal and professional life. I believe mathematics is essential to a higher education. Even if the skills learned are never used in the "real world"; it develops analytical thinking.

I have opened my mind more, you can't learn math with a closed mind. I know it's important in everyday use. Knowing can also boost your self-esteem; therefore improving a person's life. Math will also be very important in my future job and will definitely add to the furtherment of a career.

Math is totally problem solving. The constant practice of this helps a person become more organized because life is like a long assignment with problem after problem. I am confident in learning math because I demonstrate a good capacity for logical thinking, which I believe is what math truly is. Mathematics lays down a foundation for creating a systematic solution for solving problems.

Learning math is important because I need it for many things in life. Learning math is interesting and can be fun. Math increases reasoning also. It is handy to know.

I do not like to study math. I guess because I do not think that it is very interesting. But I do know that it is something that I have to learn and have knowledge that I have to learn and have knowledge about. Because it is something that I will use for the rest of my life.

In past semesters I have done **no** homework. This semester I decided to actually do the homework- I actually understand quicker this way. Since I am studying and understanding math I feel more confident. Not only in class but test taking and applying it to life.

I believe that a strong foundation in mathematics accentuates the "logical" thinking process. I think that without mathematics a vast amount of scientific and technological process could not have been achieved. I believe it is a vital force in the pursuit of increased knowledge.

In order for me to proliferate my financial and social well being it is important that I fine turn my mathematics skills. One may say that my awareness for its usefulness is evident in my sewing projects, pool playing, and financial record keeping but, I do believe that higher levels (ig cos, sin, tan) are processes that I myself don't necessarily want to know, except to help my kids (when I have them) with their homework.

I suppose I need to expand my comfort zone. I believe that it is important for me to do well in math.

This is insane!! And That if I can accomplish this, world get out of my way!

Since I was young, I have not been all that great at math. I am not sure if I do not understand logic, concept, or what. I do know that once I understand the logic behind the problem I am trying to solve- I usually remember how to do it. There are so many rules to remember & so many of those "rules" have "exceptions". It is hard to keep those straight unless you work with math every day. I am not afraid of trying I just get very frustrated when I do not understand. I feel that math problems and numbers are important to some extend, but I feel the logic behind it all is most important.

I believe that mathematics is a tool that we use in everyday life. It doesn't matter if it's shopping driving, swimming, running, or working, and even shopping mathematics are used in everyday life. Mathematics is the key to efficient existence. Mathematics created computers, cars, etc.

Learning mathematics motivates my mind to start thinking rapidly and that helps me in my other classes.

Beliefs concerning efficacy

Making an "A" in my previous math class last semester has really built-up my confidence level towards math. I worked very hard at studying and it really paid-off. For the first time taking math, I feel as though I can really complete all of the levels of required math classes and be really proud of myself. I'm proud and feel empowered to be able grasp mathematical concepts. I am confident in learning math because I think as long as I put in the time and 'my' effort, that I can learn it - whatever level it happens to be.

I am confident in learning math because I know if I apply myself I can not only do it but understand what I am doing. Math used to be one of my worst subjects. I am understanding more concepts and it is becoming easier. I enjoy it and I want to learn it.

When I put my mind into learning something, and sincerely; I'll get it learned. It just might take practice, patience, and perseverance. It takes lots of work. But luckily my dedication to doing things right keep me going, even in math. Math can be hard to learn, but if you actually give it the time it deserves, you can learn it. I think the hardest part is actually spending an appropriate amount of time practicing.

Goals

Relative ability goals and extrinsic goals

Really the only reason I take math is because I have to. I haven't ever been good at it so it's not really one of my favorite subjects. Just because I'm not good at it isn't the reason that I don't like it; it's just that it gives

me lots of headaches. I need it to graduate. Really, I know that I'll need it to do things later in my life, and now.

Making a good grade on a test motivates me the most. It sometimes makes me want to study harder. This results in better grades.

I take math to show my family I can do it. To also stay ahead of my 10 year old son whose math is getting harder to check. You can't just glance at it anymore, you have to stop and think. Also, to help me in the business world; to get ready to take full time credit courses so I can get a degree.

I'm beginning to feel like I have control over math and not vise-versa. Keeping ahead helps me feel organized. I feel successful already. I made an 84 on the 1st test. I was proud of myself. Now I strive for the "A".

I learned to apply myself more to studying because making a good grade is important to me. I am taking math, for one it is required, for two it is something that I don't understand and would like to understand one day. Three, to get over my fear of math.

My major demands you understand and able to apply math at the work force.

I wish to teach elementary education in the future. So being able to teach math is a huge goal.

Besides basic requirement fulfillments, I am personally interested in several scientific fields and realize that a strong background in math is crucial to my personal pursuits.

I need to learn math to pass my T-comp test in the math part so I can get accepted in the program I want to get in. I will be using it in my type of work.

Learning math is important to achieve my career goals and to overcome a certain fear factor of understanding math. I feel math puts your mind in a logical mode of understanding.

It is required in my field of study and in my daily activities. Nevertheless everyone should study & know simple mathematics if not calculus especially in the 21st century. With the knowledge of mathematics we will be able to solve our immediate problems without depending on computers and other electronic devices such as calculator.

Motivation A better more developed understanding of math so that soon I can teach it well. And well, graduate. I have decided that ignorance in the math department/knowledge is awful. I want to understand math and be able to apply it in my daily life.

Reason I take math is to try and learn logic. As well as prepare myself for the "real world" in some ways. I am taking it to further my knowledge. And I am taking it partly because it is required for my degree. I want to learn math and feel great when I get something right. So, I guess I am kind of taking it as a challenge too.

Task-focused goals

Learning motivations to learn mathematics include to become competent and confident in an area of everyday, worldwide, all encompassing import.

I enjoy learning math now. It feels like an achievement.

I like math so I have a good feeling about learning math I also like to learn. The more I learn the better I feel about myself.

Learning math is important to me because not only does it improve my problem solving skills and expand my vocabulary but learning math also keeps me up to par in my everyday life as well.

To learn one of the most complicated languages in the world. If I can do that, I can do anything. Knowledge-just knowing how to do math is rewarding.

My goal includes knowing that I contain the ability within myself, and with confidence, to do math, I will feel better about myself. I watched that movie where that guy drives himself crazy trying to figure out the mathematical pattern to the universe and I learned something. If the

whole world is connected to math in some way, then I am happy to know a small piece of it.

Other Circumstances

Working full time and going to school is a real hand full. It is hard to put all your concentration into everything and by the end you feel so frazzled that you cannot wait until you have a break. It is so much stress that it makes you feel that you want to give up. But then you realize that you will be giving up everything you have worked so hard for.

I took english composition this semester so I'm busy at all times between history, government, English and math along with a job. . I also have a court date that I have to prepare an argument for coming up soon.

Working 40+ a week can also get in the way. I find myself scrambling on weekends to catch-up. My full-time job and all of the other classes I am taking. I try to work very hard in the beginning and throughout the semester so that I don't feel so overwhelmed by exam time.

I work 45 hours a week, travel time to and from work is approximately 8 hours a week. I have started my own part-time business, I am captain of a volleyball team at Aussies's on Thursday nights, and I also have a daughter.

Now I have the job of overseeing the construction of my complete new production facility, new house plans to engineer and I'm trying to fix my car. Now I'm not doing any worse but I'm feeling a lot of anxiety and I'm having a hard time keeping up with my assignments. .

Family activities and work often keep me from spending as much time as I should with math. I have a family (3 year old son); I work 40+ hours a week I live an hour away, therefore I can't just come up here anytime to go to tutoring.

Volunteering at my son's school 2 times a week. Tempting assignment at my old job on spur of the moment and doing the books for my own company and 2 other UT informal classes at night and coaching son's tennis team.

Building my house the first 2 weeks of school. I did not have much time to study and I was exhausted so I could not absorb much in class.

Watching television, relaxing, eating, being on the internet, talking on the phone, laziness, sickness, cleaning house and mowing the lawn. Although all these examples may come into play at one time or another the main key to blame if I am not successful in learning math would be myself.

Teacher's impact

Maybe if the teacher compared the math we learn to "real life events," then it would be easier to comprehend.

I feel involved in learning in math class when the teacher shows that interest in the questions and concerns that you have. Also when I am understanding the material and feel confident of what we are learning about.

Learning math to me is not all that great. I guess because I never been very good at it. The only way that I can understand what I am learning is if the teacher shows that she or he is interested in my questions. And also understands that if I don't know then; I am going to ask questions.

I am confident in learning math because of having a good teacher. This makes all the difference in the world. As long as I am happy with myself and my teacher, they are good. I tend to not do well when I am unhappy.

If you have a teacher that is understanding of outside life and problems and who enjoys teaching math, then you would have the best environment to learn in.

I enjoy taking this class because my professor gets the class involved as well as at a fast paced and high energy level. Proud to have been in his class because he exemplifies the reason I chose a community college. The professors seem to want to know who they are teaching and to adapt their teaching to help the student.

I feel my professor has a well developed teaching approach. His demeanor is confident yet casual, a nice alternative to the more stoic, gargoyle-like math teachers I have endured in the past. He has the talent of being a teacher as opposed to someone who knows what he is doing but can't teach me the same. He can teach a class instead of talking at a class.

I am confident in learning math because I've had pretty good teachers, who would help me to understand. They would make sure I understood before moving on, not just me, but everyone.

I am impressed by the caring and concern I have seen demonstrated for the students by the teachers. I have only taken 4 classes, but in every class the teachers stress the importance of building a solid foundation. The serious students can really excel in that kind of learning environment.

Part II Student Case Studies

The case studies resulted from interviews with three students referred to me by non-course based remediation coordinators. Each of these students had stopped attending their mathematics course and were studying in a non-course based program to continue learning developmental mathematics.

Yvonne-Student Case Study #1

Yvonne was overloaded with activities and I had to call and e-mail her for six weeks in order to meet her on her campus at a time convenient for her. She did not respond when I tried to confirm the first appointment she had set up with me. She was working with a community college assigned tutor/teacher since she had not been successful in the developmental mathematics program.

Yvonne believed that mathematics was difficult for her to learn and she had no interest in it. Money interested her, but money and mathematics had not been important in her family when she was growing up. She explained,

> When I began to go to school and learned that I had to obtain mathematics knowledge to get education as part of the curriculum, I formed a dislike for mathematics. I just never have been able to really get into mathematics especially when they bring the alphabet in, too. I just had an interest in other subjects way more than mathematics. I utilize my energy in the more liked subjects rather than in the ones that were disliked. I tend to gravitate to subjects that I enjoy and mathematics wasn't one of them for the simple reason that I never really could understand.

She explained that she had not had a professor or teacher explain mathematics in such a way that she could understand. She lost interest in mathematics in junior high school. She expressed that she did not like mathematics when she was younger and still did not like it in college. She said that she barely passed her developmental mathematics courses which she took at the community college rather than at the university at which she was co-enrolled. She chose a major that required only one college algebra course. She was glad that she did not have to concern herself with higher-level mathematics courses.

Yvonne believed that mathematics was not her "forte." She had felt discouraged in attempting to learn mathematics for two years in college and she repeated developmental courses. Since she did not like mathematics, it was the last homework that she did, always at the last minute, which she knew caused her

poor performance. When she went to class without having done her homework assignment, she would have a high level of frustration. She did not utilize the free tutoring lab on campus. She had taken the state-mandated TASP test 3 or 4 times, but she had not passed it. She planned take it again. She was "hopeful" that she would pass it the next time.

She thought mathematics was frustrating for her because she did not have an interest and she did not apply herself. She explained that she did not make herself enjoy mathematics although she enjoyed the courses in her major. However, she did enjoy simple arithmetic with natural numbers. When she did not understand something, she did not like it. In pre-algebra, she got lost. She did not understand and learn the operations with "negatives and positives," so she did not apply herself. She believed she had a weakness in mathematics.

Yvonne explained that she did not see a need for mathematics unless someone planned to be a doctor or engineer. She explained that she was doing an internship and not using mathematics. She did not believe that she would need mathematics at any level in her career.

She believed she had had some very bad professors. She explained that some of her foreign professors could barely speak English. She attributed her lack of understanding to their scholarly level of knowledge of mathematics and their inability to explain what she needed to know in simple terms. Her

perception was that if a person knew everything about a domain they had difficulty breaking that knowledge area down for others to understand at their lower ability level. She believed that she had not had a good mathematics professor who could explain well since she had been in college. Yvonne finished the semester in which she was interviewed with a tutor/teacher provided by the college, whom she believed was doing better for her for her TASP mathematics preparation course. According to Yvonne, her current teacher took her time and was patient.

Richard- Student Case Study #2

Richard explained that the main reason he was learning mathematics was that the school required it. He would have preferred to have studied basic math, geometry, and how to figure interest. He believed these things to be very important. He said he would have liked to have taken mathematics that was more closely connected to his interests. He would not have taken algebra if it were not required. He did not feel that knowledge of algebra or calculus was needed for his degree plan, since he was an illustrator. He could see if a person "knew geometry it might be a little bit of an upper hand." He believed that in his life all he used was basic math and geometry, and offered measuring as an example. He sometimes used the ruler and the T-square in his work. He believed that scientists needed more mathematics than he would.

He was attempting to learn the "TASP stuff." He had previously passed the reading and writing components of TASP but he was having trouble with mathematics. He had never liked algebra in high school because there were too many distractions "like girls and stuff like that." He had not understood a need or a reason for algebra, therefore he did not give it his full attention. He had recently withdrawn from his mathematics course at the community college, although he was required to continue to take mathematics until he acquired the mandated level of proficiency.

He felt "really emotional about this TASP." He believed that he had wasted his money trying to learn mathematics when he wanted to study "important courses" that were in his career plan. He wanted to study and learn only those subjects that he believed he needed, since he was almost thirty-one years old and ready to move on. He believed that studying mathematics was "not so fun to study as other subjects because students did not talk to each other." He became involved in a study group that included young women and was successful in learning elementary algebra in a class that included daily group activities the following semester.

Cameka- Student Case Study #3

Cameka described her motivations for learning mathematics as being the requirements for her degree plan, in which her major required only one college

algebra course. Her previous experience with mathematics was learning it or paying attention to it long enough to pass, and then she would "let it go." She attributed her dislike for mathematics to a high school geometry course. Her father was "excellent" in mathematics. She took pre-calculus in high school, but she did not remember it. She explained her recent decision to "retain the information that I'm learning." She now realized that mathematics was "very interesting," in contrast to her earlier beliefs. She was happy to be learning, with plans to use her knowledge and skills. She believed she was using her mathematics knowledge as a single mother raising her ten-year old son. She was working two jobs and going to school. Her life was always "hectic." During the semester I interviewed her she had taken the TASP test and missed it by 16 points. She was working in an independent study program with a college provided tutor/teacher and she planned to take another algebra course. In past mathematics classes she had managed to memorize enough to pass the courses. Now she understood that a person could work problems more than one way and she felt more comfortable with herself in mathematics.

Cameka believed that her change concerning mathematics came with maturity, especially the maturity of being a mother. She realized that she did not want her son to learn for a semester and then forget what he had learned. She explained that she now realized why it was important to learn mathematics

enough to use the knowledge. She believed her reason for change was that she was becoming more responsible and was realizing the importance of using mathematics. She did not know if a person, such as a teacher, parent, or friend, could help another gain this realization, except perhaps by conversation.

One of her mathematics teachers suggested that she take one of the anxiety courses for better test taking. She learned to wake early and calm down. She believed her anxiety had passed. Mathematics was the only subject she had trouble remembering. She loved school, learning, and classes. She believed she had programmed herself to hate math so much that she previously had blocked herself from learning. She said that she had programmed the dislike but once she learned that it was not as bad as she had thought she was fine.

She described her developmental mathematics teacher as "excellent." He made her want to learn because he was flexible in working with students. If there were several ways to work a problem, he was "willing to show all ways to work a problem so that everyone could grasp it." He was willing to work to make sure everyone had a clear understanding.

Another thing that caused Cameka to dislike mathematics in the past was that she had a problem with "negatives and positives." She reversed the signs inadvertently and would end up getting a totally wrong answer. Her developmental mathematics teacher would give students partial credit for

working the problem partially right. In her case, she believed that was a motivation because it made her pay a lot more attention and double check her work.

She believed the most positive influence in her life was her son. Raising her child was "a whole new thing." The older he got, the more she realized her own need to learn. She was seventeen when she had her son. Now that they were both older, she believed they helped each other study. She perceived a duty as a role model for her son as to why he should study. For a period of time mathematics was a "hindrance" and a "headache" to her. She thought "there was no rhyme or reason for why we would have to do this. And another thing, I just felt like math was a useless subject. Except just adding up your money, the simple things." Once she learned "what it meant" she could remember mathematics. She now believed she could "see where everything fit in. Everything fell into place." She said she enjoyed learning mathematics in her current semester. She said she believed that she was "retaining information and understanding. The whole concept of understanding; when you don't understand what you're doing; you're just doing it from memory; it's just useless to you." She believed that her attitudes were more positive than in the past. She believed that attitude was everything. She believed that if a student did not like a class or professor, or did not understand the professor, she would not do as well in that

class as if she were happy and understood "what was going on." She believed that even if students did not feel a need for a subject they would do better in classes when they liked the professor.

Part III. Faculty member case studies

Developmental mathematics instructor #1:

Mary was very popular with students and, by all accounts, respected by her colleagues as knowledgeable about teaching developmental students. She taught developmental mathematics at a major university as well as at a community college throughout this study. She told me that her boss at the university admired her teaching style. She was later hired full-time at the university.

Mary tended to be a nurturing person, and she said that she never got upset with students' asking questions. She said, "I never make fun of anyone. If it's the 10th time explaining something, I'll do it as if it's the first time." She attributed a high intrinsic value to each student. She said she was very flexible with students and that many students expressed being comfortable with her teaching style and how she conducted classes. She believed that respect was important and explained, "I think that teachers who have a lot of power need to be respectful of their students' feelings just like you expect students to respect

you." Recall from the literature summary that respect for students' feelings was an important aspect of motivation.

Mary often talked to her students outside of class. She explained, "I want them to feel comfortable. We deal with more mathematics anxious students than the higher level courses, and I have had some students just really torn up over performance." Though no longer in her class, many of Mary's former students continued to seek her advice, often attending her office hours. Frequently students chose to register for second or third courses with Mary.

She regularly led discussions on test taking skills in which students shared tips and learning experiences. During these discussions, students learned that their mathematical anxieties were real and widespread. Mary understood that the level of mathematics anxiety was probably higher in developmental mathematics students than in college level mathematics students. She helped students put things in perspective by reminding them that their worth as human beings was not based on a test score in mathematics.

Mary believed that younger and older students frequently differ in their motivations for learning developmental mathematics. She was surprised by the number of younger students who told her that they were in college because their parents made them. Mary mentioned that, generally, her younger students missed class more frequently and did not pay attention in class although she did

not see these activities in her older students. Her older students said that they needed mathematics "to improve their lives." Some of her older students expressed satisfaction when they understood mathematical concepts they had not earlier understood. Others explained that successful problem solving provided satisfaction. She remembered that one student wrote, "that she is learning to like the feeling she gets when she can understand something and can work the problem." Mary described several students' communications on this topic as "almost a feeling of empowerment when they can finally understand a concept and use this knowledge to correctly solve a problem."

Mary claimed that her older students generally saw developmental mathematics as more important than her younger students. She said the older students "try to really understand; maybe because they have more experience. They've been down the road a few times. They realize this is important and they need to learn this." She said that the older students wanted to get their money's worth. Mary observed of her evening students, "90% are married with children. These are very busy, serious students." She said that they felt a "big time constraint" because of their jobs.

Mary believed that teaching developmental mathematics took a great deal of thought and planning. She mentioned that for years she would sit in Sunday Mass and consider how she should introduce a new topic the following day. She

gave careful attention to helping students connect new concepts to prior knowledge. Mary admitted that she attempted to persuade students by, "trying to sell them on my topic. I'm trying to persuade them. 'This is something you will know; this is something you can understand.'" Mary gave a post-test survey after her first test that listed

> ten things they could do to help them study. Rework homework without help...and after a while they start to catch on. You have to be pro-active and pretty assertive to understand and to learn the mathematics. It's not something that you know automatically, that you are born with; it's something that you have to develop. We talk a lot about those things.

Mary successfully convinced many students to study mathematics. She was a nurturing, patient, flexible instructor who integrated study skills and dealt head-on with mathematical anxiety in her carefully planned instructional design. It is not surprising that many students wanted to continue to study with her.

Developmental mathematics instructor #2:

Helya had been had been teaching developmental mathematics for eight years. Her students were surprised when she told them she received her undergraduate degree from a university in Iran. She said that her students found it "interesting to see a woman from that culture where women are supposed to be oppressed and not being able to do anything, yet she has learned this much and has had this much education." She said students find that "it is interesting for

them to see me, who has come from a supposedly undeveloped country. And still I have gotten all this education."

She told her students, "when I learned math in Iran, (my classes) were all in the Persian language." She said, "I'm relaxed about my identity. I told them that I try to speak clearly. So I told them, 'You tell me whenever you don't understand. Don't worry about it; just ask me; I'll repeat.'"

Helya believed that an important aspect of teaching was caring about students and their learning. She said, "Basically, I care. I care about their performance. I care about if they are learning. I go out of my way to help. And I'm sure all of this has an effect." She called her students on the phone if they repeatedly did not show up for class. She explained,

> The more it goes, I realize how much the human factor is involved in the relationship between the teacher and the student. If you just accept the way they are, no matter how they look, no matter what color is the hair, no matter what their race is.

Helya explained that she "realized, if they are treated as adult human beings as opposed to 'just a student', then their motivation level goes up." She explained that she must respect her students regardless of their abilities, moreover, she always spoke kindly to them. She said, "I never ever respond negatively to a question, even if one of them might think it is a stupid question."

Helya explained that careful explanations usually result in the beginning of understanding when she said,

> It really makes a big difference how we explain a topic. Like the job problem, I can just throw at them the formula. But I have noticed that when I explain to them what happens when people work together or not together, so why we do what we do. They understand it better. Then when they understand it, they enjoy it. When they understand a particular topic, then they enjoy it. And when there is joy in learning, that is equivalent to motivation. Their motivation level goes higher.

Helya said she used simple, easy language to introduce concepts in a new topic area, especially in more basic developmental courses. Helya said that when her students found they could understand mathematics, their motivational level went up.

Helya explained relaxation techniques to her mathematics anxious students and she offered flexible grading policies, extra help in the learning lab, or extra credit for extra homework problems for some anxious students. She did not want those who were working hard to get discouraged. She realized that her students "have other problems in their life and are here to get an education and improve themselves."

Helya encouraged her students to enjoy learning mathematics and modeled enjoyment doing mathematics in her classroom. She mentioned a student who told her, "'You are really having fun up there.'" According to

Helya, "This is nice" when students perceived "She is interested herself, rather than just having a bored face."

Helya noted that older students have different motivations than younger students. She explained, "The returning students know why they are going to school. They are very determined and know what they want to do. They tell me that they have done minimum wage jobs for years; I can say that more than 95% of older students are very motivated." She contrasted motivations of her older students to those of "the younger students, the reason they are here may be the force of their parents; if they are paying and their age difference." Helya continued, however, "I've had younger students who have been very motivated. It is very interesting to me to know why. Most of them are not."

Helya continually persuaded her uncertain students that they could succeed, that "they can do it." One way she did this was to make a transparency from first day comments from students from previous semesters, followed with the final course grade that each made. The students' comments recalled lack of previous success in mathematics, the years since they had taken their last mathematics course, and other personal mathematical anxieties. Helya said "I kind of provide them with examples written from some of the people who thought they couldn't do it in the past. Some who thought they couldn't, but then made A's in my class." Care and respect for students, careful explanations

in simple language, attention to mathematical anxieties, expressed enjoyment in doing mathematics, and planned persuasion that students could succeed in learning mathematics are all important parts of Helya's instructional design.

Developmental mathematics instructor #3:

Craig was an award winning professor with many years of teaching and administrative experience at several community colleges. He was especially interested in developmental courses and business calculus courses. He was very popular with both students and faculty members. Students said that he explained mathematics concepts clearly, was cheerful in class, and maintained very high standards for performance in the courses he taught. Students and faculty both told me that his tests were challenging.

Craig explained that some developmental mathematics students "don't really see the immediate benefit of [mathematics]. To a certain extent, they don't see it as directly related to their career goal or degree plan." He also described other primarily older, developmental mathematics students, who "definitely want to achieve," and were "generally working and many have family responsibilities," as "definitely motivated to learn." Craig said that some "are motivated just because it is a degree requirement and they know they've got to do it." For some others, he explained,

> Others, especially ones that really have to struggle with it, don't have motivation intrinsically. They are not naturally interested in the math.

> They don't know and see how it relates to their career goal or their degree. Some are even argumentative about why they have to do it.

Craig described some students who had conflicting desires or conflicting responsibilities. He described students with work and "class schedules that are totally unforgiving." He said if they had the "flu or whatever, they can never catch up:...even if I offer to help them by being flexible like dropping a low test grade or something. They just don't have the time to do it." He said many students do not have the time to study for a college course. Craig observed that many students have an unrealistic expectation regarding the amount of time and effort necessary to successfully complete a course. According to Craig, some students, "have not developed study skills or time management skills in the first place in high school."

Craig contrasted older motivated students with many responsibilities with younger students in the same classes who "really are not mature enough to appreciate the opportunity just yet. They may be still living off their parents." He described some of these students as "looking at themselves as children" in terms of accepting responsibility. He also said that some of these students did not take science courses to use mathematics in high school or dropped out of high school. Craig said the problem "of their not really understanding what is involved in learning" became more serious for students from developmental courses, in part, because they lacked knowledge of mathematical applications.

Craig explained mathematics concepts clearly, was cheerful, and offered students a learning challenge. He believed that some students did not commit enough time to attaining an education and he claimed there were strong differences in motivation between younger and older students.

Developmental mathematics instructor #4:

Mac was a knowledgeable professor and developmental mathematics textbook author. He had more than 18 years of experience teaching developmental mathematics students and had served as developmental mathematics department head for many of those years at a large urban community college campus.

Mac noted that the backgrounds of students in developmental mathematics courses were diverse. He said that if students "see math as being directly useful, then they are interested." He continued, though, that "if they see math as a requirement that they have to pass here or down the line at a university, then it varies." Mac wrote, "Students are always more motivated when they have interest in the material or see some benefit in learning it. Clearly those who intend to go into fields which are math intensive see the need to learn it well." Mac explained,

> A second group of students who are highly motivated are those returning older students, particularly women, who have been out in the world and now are returning with the desire and/or need for a degree. Women in their late 20's to early 40's, who have had children and are now returning

> to get a degree, are often the most zealous in trying to meet all expectations. They are often upset by receiving less than an A and sometimes need to be counseled to reduce their anxiety level and accept something less than perfect.

By contrast, Mac said that "many of the students just coming out of high school are unmotivated and they really don't know why they are here." He explained,

> Many in this group of students would not have come to college in the past. They were unprepared before and they are still unprepared. They have fewer opportunities now to earn a good living without an education.

Mac explained that younger students usually do not have fixed career goals. Yet, "many of them had this material before so they feel like they already know all of this when, in fact, they don't know it well, and they continue not to know it afterwards because they don't pay attention." Mac believed that "if they are going to go to school they ought to want to go to school. They ought to be willing to do these things."

To motivate students, Mac said that he talked to students individually, especially ones who stopped attending. He called them and tried to encourage them to return to class. He said most of his students appreciated his having "enough concern to call them at home, even if they can't change the circumstances." He said "they just have too many other conflicts, other things that require time."

He believed in "trying to find things that will interest them." He explained that he also tried to be pleasant when he told his students honestly, but kindly, that "some of their skills are not quite up to what they need be." Although he discussed this situation with them early in the semester and in a non-threatening manner some students still resented it. Occasionally, Mac took cookies to class to express his appreciation and concern for students.

In his views Mac distinguished the intrinsic motivations of some students from the extrinsic rewards that influence others to learn mathematics. Further he ascribed certain goal orientations to certain categories of students. For instance returning women, for the most part, had different goal orientations than younger students many of whom did not have established career goals. He tries to interest his students in learning mathematics, to be pleasant, and to show care.

Developmental mathematics instructor #5:

Margaret had fifteen years of teaching experience in mathematics and developmental mathematics. Her Ph.D. was in mathematics, and she was particularly interested in the motivations of developmental mathematics. She placed a high value on students' self-confidence. She believed that student self-confidence was a factor that instructors could enhance. She suggested that stronger self-confidence might influence students' persistence.

She told me that some students wrote in their learning journals that they could not understand mathematics, though her impressions and records indicated that they were doing well. According to Margaret, some students struggling with developmental mathematics did not realize they were making reasonable progress, and that the progress revealed understanding of a sort. Margaret feared that frustrated students might give up when they were actually doing fairly well, but did not assess their achievements accurately.

Margaret was shocked by the extreme anger expressed in the journal writing by one high-achieving man in her class who did not allow his journal to be submitted for the study. He wrote that he hated mathematics. She would not have known of these strong emotions and negative attitudes if she had not used the student learning journals. She sometimes tried to draw him out of his quietness, but she was very careful.

Margaret believed that most of her students were motivated by their desire to take college credit courses after passing the TASP test, while some of her students really wanted to learn mathematics for its own value. One of her students inspired fellow students because of his great interest and enthusiasm. Margaret believed that enhancing students' self-confidence or self-efficacy enhanced students' motivation to learn developmental mathematics in spite of the diverse factors which could impair motivation.

Summary

During this study, I received student learning journals from more than one hundred students. There is a student learning journal sample in the Appendix. I coded 119 student learning journals that I received from seven other instructors including a few journals from my students. These students made grades ranging from A's to F's as well as some withdrawals.

Several students indicated that their motivations to study mathematics included their goals to take more mathematics courses to support their career plans or to pass the state-mandated TASP test. One mentioned the idea, "success in math indicates success in other subjects and ability to handle situations." Several indicated that working full time and taking other classes kept them from investing sufficient time and energy required to do their best in learning mathematics. Frequently students mentioned satisfaction or enjoyment at having learned to solve problems, while others expressed fear and frustration. Many students attributed their progress in learning mathematics to their instructor. One wrote that he thought he learned best "when my professor explains slowly and in detail and specially when she is using different ways in solving the problem." Another typical response attributed achievement in learning mathematics to the student's own efforts. One student wrote: "In high school, I didn't study math and didn't do very well. Now I study everyday and I'm doing better than I ever

have." Although many students attributed their progress to extrinsic demands, other students clearly benefited from understanding their own task-focused and relative ability goals. Extrinsic and intrinsic motivation were not mutually exclusive. Many students claimed to have some aspects of both at once.

CHAPTER 5. FINDINGS

Since this study was a naturalistic inquiry, which had the purpose of investigating students' perceptions about their motivations in developmental mathematics classes, the findings of this study are not intended to be generalized. However, there are certain general themes and patterns that emerged from the data. The themes and patterns are grouped by topics of understanding; goals; attitudes, emotions, and beliefs; life circumstances; values; and teacher's impact. It would be interesting to investigate whether the themes and patterns found in this study can be found in the perceptions of students in other groups of developmental mathematics students.

Data collection and analysis began as I did emergent interviews of faculty members; then continued with my collection and analysis of the primary data, the student learning journals; and concluded with the emergent student interviews. In reviewing the faculty interview transcriptions, my use of colored pencils helped me code the data efficiently. I developed codes from the data, while keeping certain motivation theories and models in mind, such as goal theories, extrinsic and intrinsic theories, and attribution theories, along with Keller's ARCS model. Next, I input, unitized, and applied codes to the student learning journals and student interviews. I began by applying the existing codes that I had developed from the faculty interviews to the first of the student

learning journals. I expected that faculty and student views would differ significantly and I would need a different set of codes when I analyzed student data. Thus, I was surprised that the existing codes from faculty data analysis conformed closely enough with the student understandings to become some of the first codes for analysis of the student learning journals. Gradually more codes were needed as new patterns emerged from the student learning journals.

I used NUD*IST software after the first semester to help with unitizing, coding, and searching for emerging themes and patterns. These emerging themes became working hypotheses to be tested against the data and discussed in the peer-debriefing group. I organized and synthesized my original working hypotheses into provisional findings as I continued data analysis.

According to Erlandson et al. (1993), working hypotheses in a naturalistic inquiry are different from the scientific method hypotheses common in traditional research. The purpose of this naturalistic study was to "develop shared constructions that illuminate a particular context ... for the investigation of others" (p. 45). They described working hypotheses as, "general statements applicable to the specific context under investigation" and intended to "give meaning and direction to the research" (p. 61). In the following we have distinguished low achieving students from other students where appropriate so as not to neglect the views of students who were low achieving.

Primary Findings: Many low achieving developmental mathematics students allowed emotions or attitudes to inhibit their motivation to learn mathematics. However, when they achieved some early success in their mathematics classes and learned to believe that mathematics was useful and/or interesting they began to move beyond their affective barriers. These students, who moved beyond their affective barriers, constructed new motivations, based on perceived relevance of mathematics to their future goals and occasionally on their present personal interest. Students realized that understanding mathematics was essential to their motivation and increased their confidence in learning mathematics. It is important to note that motivation was not necessarily a precursor to understanding. Rather, understanding mathematics seemed to enhance or trigger students' motivation to learn mathematics at whatever point understanding occurred.

Understanding

More than any other single idea, students talked and wrote about understanding of mathematics. For example, one low-achieving student wrote, "I feel involved in learning in math class when I am understanding how to do the problems. I like to learn math once I understand how to do it. I'm really starting

to like ALGEBRA where I didn't a few months ago. I find myself studying more because I understand it now." This student believed that her understanding resulted in her beginning to like algebra, in contrast to her attitudes toward algebra in the past. She also found herself studying more because she understood. Another student expressed the similar belief when she wrote, "Mathematics is important in the medical field so I get motivated. I also get motivated when I'm understanding the math as I go along. When math is not so stressful I enjoy learning more." This student, too, identified her understanding as a motivation to learn more mathematics.

Low Achievers on Understanding

While many successful students connected understanding to increased achievement motivation, students who were not yet successful also described understanding's impact on their motivation. For example, one low-achiever wrote, "Because I understand it now I feel better about math. I am really starting to like math now." Another wrote, "I like to learn math, I really like it now because I understand it more now. But I don't understand why we have to learn somethings that we will never use." While another low-achiever explained her progress when she wrote,

> Some of my attitudes about learning math are not usually positive. I am working on all of that. I believe it is all a mental block. Since I'm working on unblocking my fear, my attitude has gotten better. I really didn't have strong math teachers in high school. I have never been confident because I thought I would never understand it. Since, college I am very slowly gaining some.

Though she believed that she had begun to make progress, this low achieving student had thought she could never understand mathematics and she had not been confident in learning. Like this woman, other students frequently mentioned poorly developed mathematical backgrounds. These student perceptions support the findings of Zazkis and Campbell (1996) who found that poor development of the basic concepts of arithmetic often lead to pre-service teachers' lack of mathematical confidence. They explained, "the successful development of conceptual understanding in algebra requires a firm grounding in the conceptual understanding of arithmetic and elementary number theory" (p. 562). Some low achieving developmental mathematics students had little development of understanding of the basic concepts of arithmetic so they were not confident in their understanding of algebra.

A female Hispanic student who failed her developmental mathematics course wrote, "There are times when I am so excited because I actually understand and am doing a good job, but of course there are those times when I have an over all negative attitude and wish math was as easy for me to

understand like all the other subjects I'm taking." This student was excited when she understood mathematics.

A student who entered her developmental mathematics class with little previous mathematics knowledge wrote, "I learn math because I want to learn how to work the problems, and to understand what is going on at the same time. Plus we need math every day even when we least expect it." She was motivated to learn problem solving and to gain understanding; and she had begun to realize that mathematics was relevant to her life.

Other Students on Understanding

One student wrote, "I'm trying to make an effort to learn and have better understanding of math. I understand that if I do this I can do better in my other classes. Also, when I can solve problems and get them right it motivates me, gives me confidence to continue." She believed that if she understood, she would have higher achievement and this would influence her work in her other courses. A common idea was, "I guess I feel pretty motivated if I have a problem w/ something and end up understanding it,"

A twenty-something Hispanic woman described her experience in understanding in terms of a construction of a mental model when she wrote, "I remember the day when the math tutor explained word problems to me (I'm a

very visual person) at one of our sessions...I was so elated!!! He first drew the picture of the problem then showed me that there is nothing wrong with looking at math visually...almost as a child." She constructed new understandings that could enhance her learning and her motivation. Her breakthrough in understanding resulted in her heightened motivation. A young Hispanic female who made a B grade in the mathematics course wrote, "Math used to be one of my worst subjects. I am understanding more concepts and it is becoming easier." She attributed her higher achievement in mathematics to her increased understanding, even as it was becoming easier for her.

A thirty-something Hispanic mother of three wrote, "I force myself to start my homework even though I don't want to. Once I see I understand, it excites me and motivates me to complete my assignments." Here she clearly described understanding as enhancing her motivation. Expressing other goal structures she wrote, "[I feel] excitement and interest. I like math because it has structure. Once you understand it, it is fun and exciting to comprehend. I have the desire to learn so I can help my children. Also my degree plan requires it. I love a challenge and am overjoyed when I achieve the knowledge." She described understanding as a necessary step to making her learning fun and described it as exciting to be able to comprehend.

Another student wrote, "I feel involved in learning in math class when the professor asks if we understand and he helps us when we don't. The professor always asks for our input every class session. This makes me feel involved and makes me want to keep going." This student expressed high regard for a professor who involved students to promote understanding with the result that the student wanted to keep going, that is, had heightened motivation.

An average achieving, young African-American female wrote, "I feel involved in learning in math class when I understand the problem. When it's thoroughly explained to me, or when I have a picture drawn, I feel like I can really comprehend it, versus just being given a section and told 'Go!'" She noted that when instructors provided adequate explanations or visual images she was motivated to "go", that is, explanation and understanding lead to motivation.

Similarly, a high achieving thirty-something female wrote, "I learn best when my math professor explains a concept in another way to give a different perspective on the understanding of the concept. I feel involved in learning in math class when I understand where the instructor is going with the lecture." This student recognized the value of the teacher's thorough explanations using more than one approach in promoting understanding which, in turn, motivated her greater involvement in learning mathematics.

A successful student wrote,

> (S)ince the first comments I made in here or suggestions I have made, my teacher has always tried his best to take them into consideration and I appreciate that. He is a great and fun teacher. He does not make math feel intimidating like teachers I have had in the past. He makes sure you understand before he goes on.

This student described a great teacher as one who promotes understanding and reduces the intimidation in learning mathematics.

A high achieving, young female wrote, "I feel involved in learning in math class when the teacher shows that interest in the questions and concerns that you have. Also when I am understanding the material and feel confident of what we are learning about." Still, another high achieving young female wrote, "I feel involved in learning in math class when the teacher takes time to listen to the students. When the teacher asks us how we are understanding, and allows the class to giggle a little. Involved = having fun." "The best part of class is bridging that gap between reading and understanding," reported still another high-achiever. As we anticipate later topics in this study, one young man described the change that took place in his understanding and how that change effected his beliefs, attitudes, and achievement in mathematics when he wrote,

> My beliefs concerning math have changed a great deal. In my early years I hated math, but I did try to comprehend its logistics. In high school it was the same, the only class I did well in was math of money I had a 90 average. Recently since I have graduated high school I have completed

> one math course and made a 92 average. I seem to be understanding a lot more than I have. I feel math is a very useful tool in the real world.

There were many, many occurrences of students expressing a link between understanding and motivation. This supports Grouws' (1992) claim that students' understanding is one of the most crucial issues in teaching and learning mathematics. The National Council of Teachers of Mathematics (NCTM) *Handbook of Research on Mathematics Teaching and Learning* devotes an entire chapter to discussion of student understanding. Hiebert and Carpenter (1992) explained that understanding is possessing a connected network of mental representations of the idea, procedure, or fact. The findings of this study support Hiebert and Carpenter's (1992) suggestion, "It also is plausible that the process of building understanding influences students' beliefs about mathematics."(p. 77). In addition, concerning the relationship between understanding and motivation, the findings of this study align with Middleton's (1999) report, "for the first time her students knew why they should understand graphing and algebraic symbolization, and this... stimulated them to learn the content." (p. 356). Middleton's teachers, like the participants in this study, reported that understanding mathematics seemed to stimulate students to learn more. As a factor impacting motivation, understanding may link with efficacy theories of motivation.

Goals

Students wrote that their goals influenced their motivation to learn developmental mathematics. The participants in this study frequently cited task-focused goals, extrinsic goals, and relative ability goals as having impacted their motivation to learn mathematics. Few students mentioned performance avoidance goals of not wanting to look stupid in comparison to others, while very few mentioned work avoidance goals.

A young man who made an A in his developmental mathematics course wrote,

> Learning math is important to me for many reasons. First if you don't comprehend math you feel stupid especially when others around understand. My father has always been exceptional at math and I would like to make him proud. That sounds corny but it's the way I feel. Finally I would like to know math because it will help me with my business, managing money, etc.

This young man expressed several goal orientations at once. He wanted to know mathematics to help with his business and managing money, which were extrinsic goals. The student wanted to make his father proud, which was a relative ability goal. He did not want to "feel stupid" when others understood, which described a relative ability goal orientation.

Low achievers on Goals

One young Hispanic female, who wrote that she hated mathematics, did not do any assignments, and always did poorly in mathematics wrote that her motivation for taking mathematics was to make money. Her desire to make money was an extrinsic goal that sounded like it might be a dream rather than an active goal since she did not finish her developmental mathematics course that semester. Her failure to do any assignments indicated possible work avoidance goals perhaps precipitated by her past low achievement. Understanding relationships between mathematics learning and life's broader goals might be important to some developmental mathematics students. The young woman's desire to make money after studying mathematics amounted to a vague dream rather than an active goal that she actively pursued.

Others wrote that they learned mathematics in order to attempt to pass the TASP test and they had to take mathematics for their major. These were short-term goals, but nevertheless, they were goals that did influence some students. Very few low-achievers expressed task-focused goals like the one who wrote that her goal was, "just to learn more."

Other students on Goals

A young African-American woman who earned a "C" in the course expressed her relative ability goals when she wrote, "My motivations in life to learn math is my mom and the teacher that I have. My mom is a big part of my life and she has always wanted to know what I am doing. That includes math even if she doesn't know the answer, she tries." In addition, for her future goals she indicated a task-focused goal, "to gain competence in math to gain understanding, insight, or skill". She also wrote, "my attitudes about learning math are not good. I don't really prefer to learn math because it stinks. But I don't mind knowing it." She was typical of students who described more than one goal orientation. She described relative ability goals related to her mom and teacher and, at the same time, she chose task-focused goals of gaining understanding, insight, or skill.

A young Hispanic female described two goal orientations, "I only take math because I have to. Part of my basics. Learning math is important to me because I don't want to be ignorant to the new things." Her extrinsic goal was that she had to take mathematics as part of her basics for her academic program, but her performance avoidance goal was that she did not want to be ignorant.

A twenty-something, Hispanic, 'B' student who described himself as math anxious expressed several goal orientations when he wrote,

> My motivation includes improving my understanding. Mathematics is needed in everyday life. Another motivator is because it's required. Learning math is important to me because I need it so I won't look stupid when I come across a situation where it will be needed. Learning math is also important to me because my brother has always been real good at it and if he can do it, I can too.

His task-focused goal was improving his understanding. His performance avoidance goal was not wanting to "look stupid" when a need to use mathematics might arise. His extrinsic goal was the requirement for his program. Lastly, he expressed some relative ability goal orientation in comparing his determination with his brother's.

A twenty-something woman who identified her primary goal in learning mathematics as gaining insight, understanding, and skill, a task-focused goal orientation, wrote,

> My motivation is to meet college requirements. To know the information and pass the courses. To be able to see a problem and solve it even after not having a math class for a few years. I also plan to be doing a lot of computer programming and math is a good engineering skill.

As many students did, she indicated that her primary goal was a task-focused goal but that her motivations included the extrinsic goals of meeting college requirements and

being able to use mathematics in later years. She perceived mathematics to be useful in her future education and career, and she wanted to pass her courses; she expressed various goal orientations.

A young, test-anxious male who did little homework and made a C, wrote,

> I learn math when I'm interested in it, not when I'm forced to learn it in order to take the classes I'm interested in it. My motive is music and when I'm able to use math in music I will enjoy it more for instance. I take math because I'm required to but I would gladly learn it and practice it if I could use it for personal interest. I enjoy it and I have interest in it, I need it for everyday life, it's a key to most problems in life, and humanity has used it sense the beginning. I am confident in learning this art for problems in life such as being ripped off at the store for my money, for audio production for music, music business. My attitude is hard to determine because math has been a requirement in school and I never have appreciated math until recently (2-3 years ago). But the more open minded I become in this field the more I appreciate and love, slowly it's occurring. Well I use to not study math, but now I actually like studying math like some sort of hobby. It's an excuse now to relax and do math.

He explained his task-focused goal orientation when he said he learned math when he was interested and he relaxed and did math; he was beginning to love mathematics. By contrast, he described extrinsic requirements and needs for taking mathematics at the same time.

One African-American returning student wrote in his learning journal, "math is important to me because it is allow me to go ahead with my

specialization that requires my thinking in math skills." He also indicated that competence in mathematics to support career plans, and competence in mathematics to support study of more mathematics were two important reasons for him to learn mathematics. This student indicated that his goals included his "specialization" which required mathematical thinking. Similarly, another student wrote about his motivations to learn mathematics, "the fact that it is a vital part of computer programming; also, the more I learn the better off in life I am." He believed that he would be better off if he knew more. He wanted to learn mathematics because of his goal to study computer programming.

Like many, another student explained both extrinsic goals and task-focused goals when she wrote,

> Learning math is important to me, because I still need to pass the TASP in order to receive a degree. I want to be a speech pathologist and am only required to take college algebra. I would like to feel proud of myself and be confident that I can understand.

Her extrinsic goals included passing the TASP test, taking college algebra, receiving a degree, and becoming a speech pathologist. She also mentioned a task-focused goal of wanting to understand, be proud, and confident.

Reflecting on students' goals, faculty participant, Helya explained that she believed that strong goals motivate some students. She said, "if they have a strong goal, specifically the older students, if they know what they want to do;

then they just go through all the steps. In general, I think being motivated, it really depends on how well they can do this." Later Helya mentioned that some students' goals did not contribute to learning mathematics. She explained, "some of the students in our classes although they may have goals, they may not relate to mathematics goals...for some reason they may think they don't need math". A returning student confirmed Helya's idea by writing,

> Some teachers say you will need math to survive in this world. This is true, but I don't think you really need as much as they say. I was out of school for over twenty years, and during that time I don't ever remember being confronted with any mathematics that couldn't be solved. Maybe it's the life style you choose that determines how much math you'll need.

By contrast, Helya described others with task-focused goals, "Some students are naturally interested in learning. I've had students in my classes who did not necessarily have academic goals. But it's just they are naturally interested in learning...they are motivated; they want to learn something." Helya said the desire for knowledge motivated some students.

A young high-achieving woman who desired even more academic success and knowledge echoed Helya's idea when she wrote,

> It would make me proud of myself to know that I have the ability and knowledge to do complicated levels of math. I eventually plan to go as far as calculus and beyond. If I could do that, I'd be very proud of

> myself. Intelligence and knowledge is success. It would make me feel smart to be able to complete difficult math.

Craig explained that some students had conflicting time demands. He said, "At least from the job you get money; and from the family you get affection; they don't know about algebra unless they see the connections to the other things." Craig believed that some students really did not make the connection between learning mathematics and their goals.

Mary said of an evening class, "The majority are saying the only reason to be here [mathematics class] is to improve their life. I think that this is their way to get their degree, to get a better job." One of Mary's young female students explained,

> I take math because I enjoy doing it and also I want to be able to move up and get a better job. I feel the need to do great in it so I can be what I want to be. I get frustrated at times and have thought of just not doing it. One minute I like it the next I hate it but I am going to keep on it and continue to do my best.

Like many, this student had both task-focused and extrinsic goals for learning mathematics. Some of Mary's students saw the connection between reaching their goals and their mathematics learning.

Attitudes, Emotions, and Beliefs

Students' attitudes, emotions, and beliefs strongly influenced their motivation to learn developmental mathematics in most low achievers, and in many marginal and high achieving students. Careful definitions of attitudes, emotions and beliefs are in the Appendix in the List of Codes section. In the descriptions of the participants that follow I take pains to distinguish attitudes from emotions from beliefs even when participants sometimes mix them. Among other things, attitudes include confidence and determination or lack thereof. Emotions include fear, frustration, anxiety, hatred, and joy. Beliefs about the importance, mathematical relevance or lack thereof were commonly expressed.

A common attitude was expressed by a twenty-something woman with test anxiety and who worked long hours. She thought learning mathematics was very important but she wrote, "I really hate learning math...I still feel the same way about math as I always have (I hate it), but math seems to come a lot easier to me now than it used to."

Low Achievers on Attitudes, Emotions, and Beliefs

A fearful young woman who finished her developmental mathematics course with a 'D' explained her background, attitudes, and emotions when she wrote,

> I was never really encouraged in math very much. We moved quite a bit when I was in elementary school and math was difficult. I didn't learn my multiplication table until high school. I enjoy math once I get it, but it is the "getting it" that is hard. My attitudes about learning math are pessimistic, curious, and nervous. I am a bit pessimistic about math because I have had such a horrible past with it. I am curious about math though because once I get the hang of it, I actually enjoy solving problems because they are like riddles with numbers. I am always nervous about math because I have a fear of failing miserably.

At once, she had attitudes of pessimism, curiosity, and nervousness even while she expressed the contradictory emotions of enjoyment when she understood, and fear of failing miserably. I found the theme of enjoyment from understanding quite frequently in the student learning journals, more than I had anticipated. Another young woman who made a "D" expressed a typical fear when she wrote, "I feel scared at times because I'm not sure what to expect. It takes me a while to catch on."

Higbee and Dwinell (1996) suggested that some under-prepared students incorporate their anxieties into their negative meta-cognitions resulting in a self-fulfilling prophecy of failure, that is, the students fail because of attitudes and

anxieties not abilities. This influence of attitudes and anxieties on failure might have been the situation for the thirty-something woman who failed the final exam and had previously written, "I hate math But I try to stick it out. But not enjoying it…I continue to feel anxious."

Another young woman who finished her developmental mathematics course with a 'D' stated contrasting attitudes when she wrote,

> I am starting to feel more confident. I am trying not to freak out if the problem looks hard I just try to solve it. Sometimes I can't even get the right answer (which is frustrating) but I feel like at least I tried. I enjoy doing math when I know what I'm doing, I don't really get a thrill trying to figure it out. It almost feels like the reward for understanding it doesn't shine for me or it isn't very rewarding. But once I get a hang of it and get the right answer. It definitely makes me feel smarter.

She felt more confident than in the past. She was attempting to control her negative attitudes when she was problem solving. She still felt frustration when she did not get the answer she wanted. It is not surprising that she expresses enjoyment when she knows what she is doing, even for this low achiever. She felt smarter when she understood and got the answer she wanted.

Beliefs about determination of low achieving students included, "You have to want to learn math and understand it a little, to do at least half right." Others explained that they believed they had not tried hard in the past or this was the first semester they had put forth, what they called "real effort."

Other Students on Attitudes, Emotions, and Beliefs

A high-achieving young woman described her attitudes and emotions of hatred and frustration along with her belief in mathematics' usefulness when she wrote, "I extremely hate it so much. I understand that math is with us everyday and many people use it. My feeling about math is frustration when I don't know how to solve a problem." She further explained her attitudes and beliefs when she wrote,

> I have and need to gain math skills that I will probably use one day. I am urged to take different math courses to get a better understanding and build better skill... it is a necessary skill that I will probably need. Math helps to figure out certain formulas, questions in math, or life skills. I am kind of in between about my confidence in learning math. I am confident that I will remember certain skills from the past and not getting them confused or mixed up. I am willing to learn new ways to solve different problems. I am not confident about getting and understanding the formula to get to the answer. I don't like it very much but also I kind of like it a little. The reason I like it a little is because it is kind of interesting to learn something new. I stay up late at night to finish my homework and go to the tutoring lab for help.

Confidence and Enjoyment

A twenty-something Hispanic student, who made a 'B', explained attitudes and beliefs that influenced her achievement by writing, "Changes have affected my attitude in math in that, when I've studied enough, I feel good about what I'm doing.

And it changes my success because when I feel good about what I'm doing I do better at the things I do." This student felt good after having studied enough and she believed that she showed more achievement when she felt good about having studied. Faculty participants Mary and Helya both talked about students feeling good when they can solve problems. Helya said, "When they understand a particular topic, then they enjoy it. When there is joy in learning that is equivalent to motivation." Joy in learning, then, is strongly related to intrinsic motivation.

Mary described the importance of students' feeling good about problem solving when she said, "when you finally understand how to do a problem, boy, that makes you feel good; that is coming up in their writing. Even though they may have been struggling, when you finally understand how to do a problem, it just makes you feel so good." She explained that many of her students, "regret not having more time to explore the mathematics for enjoyment---they feel a big time constraint due to their jobs." She continued, "If a student isn't feeling good about themselves they aren't going to be focused."

A young woman, who believed she had mathematics anxiety and believed she worked too many hours, wrote, "I like the feeling of accomplishment after completion. Mathematics is fun, when I understand." A returning student wrote, "I feel very good when I understand it." This was the feeling good that both Mary and Helya had explained.

By contrast a twenty-something Hispanic male explained the challenge when he wrote,

> I feel involved in learning in math class when I understand what is being instructed at the moment. And when I am in a good mood which allows me to want to be involved. I know that math can be fun if you know what your doing. The main problem is knowing what your doing so it can fun.

Students from several groups mentioned the fun or satisfaction that comes with completion of problem solving and understanding.

Another contrast, from a fearful, young, Hispanic, female high-achiever who wrote in her journal,

> My emotion about learning math is fear. Math has a way of conquering me sometimes. All through middle school and high school, I recall spending hours studying for math tests and never making a passing grade. It became very discouraging. My lack of self-confidence in math is big. I check my work constantly because even basic math can be frightening for me.

Although she was doing very well in her developmental mathematics course, she felt fearful and lacked confidence in learning mathematics. She had become very discouraged in high school and middle school. By this example some negative emotions exist with positive motivation.

Frustration

A twenty-something Hispanic woman with mathematics anxiety and many familial responsibilities voiced frustrations expressed by many when she wrote,

> I am not confident when it comes to math because I believe that is my weakness in education and I have a tendency to block out learning when it comes to math. Frustration!! Is a major emotion. I feel that as good as I am at learning things, I just can't seem to absorb math completely. I feel very illiterate when it comes to math. My motivations to learn mathematics include knowing that I will need it to further my education and apply it to other courses like a science class.

Expressing lack of confidence and frustration, she believed that she could not absorb mathematics as completely as she would have liked but that she needed mathematics to complete her education. Another high achieving student wrote, "My main emotion is fustration. I get fustrated working a problem 5 or 6 times and not getting it right. I also feel proud when I get a hard problem right." Frustration was a frequently expressed emotion by students, with many expressing frustration with word problems.

A student who wrote that she "dreads math" wrote, "I am not confident in learning math because I've never been good at it. I get easily frustrated and discouraged when I don't grasp a concept quickly enough. I start to panic and I just quit." She wrote of her attitudes of lack of confidence and dread, of her belief in her incompetence in mathematics, of her belief about how fast she should grasp concepts,

and of her emotions of frustration, discouragement, and panic. She summed up some of her attitudes with, "It's a dirty job, but you just have to do it." She even wrote that the stress of some math tests made her, "break out from the stress and my skin gets gross and I get upset."

Another young woman envisioned herself in a classroom setting when she wrote about her attitudes, "What? Can you do that again? If I get something wrong it gets really discouraging. I am a somewhat slow learner. I really wish these courses would go slower."

Anxiety

A young student wrote, " I know I need to learn math, but past experiences have been horrid. I skimmed through high school w/low C's and after a few years off! Am anxious and nervous about learning." Another wrote, "I often feel anxious about math because it is difficult for me." Similarly a young Hispanic female high achiever with many responsibilities wrote, "Some of my emotions about learning math include some anxiousness and uncertainty. As time goes on though, and I have some practice and a good breakdown of what I'm doing. I become more confident."

Mary said, "I find this in all the developmental classes that I teach, a high level of math anxiety, probably higher than you may expect in a college level class. Very anxious." Mary described an aspect of dealing with mathematics

anxiety when she said, "In class I allow discussion of test taking skills, letting students share all their tips and experiences. This allows students to realize that math anxiety and math test taking anxiety are real, shared by many people; it's possible to use different strategies to ease the discomfort."

Depth, intensity, and range of emotions

One Hispanic woman wrote of the depth, intensity, and range of her emotions, "I afraid and scare I don't understand it and I going to have a breakdown." She had previously written, "I'm 40 years old, I have been out of school for 20 years. I work 30 hours a week, plus a family. It's very hard to find time and energy to do my best. I feel alone. The lab can't really give you a one to one attention and because of all this pressure and stress I hate math." She was terribly afraid and stressed in learning mathematics.

A twenty-something Hispanic female, who earned a 'C' in the course, wrote, "I work often and sometimes have fears of life and there-after; these thoughts consume me and during these times I feel "dis" motivated."

The depth, intensity, and range of emotions about learning mathematics were expressed by a twenty-something woman who believed that she had mathematics and test anxiety and wrote, "Word problems should be abolished! ...I would rather drill my own teeth. I would rather be in a room with a hundred cats in heat. If there was a way to learn them through osmosis, I would give up

my first born cat." She also wrote that her emotions about learning math included, "Fear of failure, of feeling stupid because I don't understand. Elation when I do understand and when I can figure something out on my own...Frustration when it keeps going over my head." She described an inhibiting attitude, "a feeling like I can't do it, it's too hard, it takes too much effort" as sometimes keeping her from investing time, energy, or effort to do her best. The next month she wrote that she was studying more than she ever had and understanding what she was doing. This woman wrote that she expected to make an A+ in the developmental mathematics course, although she made a B; she was a high achiever who did not do well on the final exam. She wrote that mathematics "is the cornerstone of our civilization, i.e. we wouldn't be where we are without it." She felt involved in learning in class when she sparked active student discussions with her questions. Her emotions played a very important part in her learning.

A young man, who earned an 'A' in his developmental mathematics course, explained a commonly expressed idea when he wrote, "I have a very hostile feeling for math. All my years in school I've never had a grade higher than 78 in math, until this year." A thirty-something Hispanic male also described his changing emotions when he wrote,

> Anxiety, sometimes overwhelmed, I feel very smart when I figure out a problem on my own. I'm concerned when everything just seems to go over my head, then the opposite occurs when everything makes sense, I feel very confident. It seems to be a roller coaster of emotions throughout this course.

The emotional roller coaster ride feeling was described by many students. I was surprised that such strong emotions were, in some cases, so changeable. These observations partially address the call for study of depth, intensity, and range of emotions in the literature.

Beliefs concerning importance or usefulness of mathematics

A high achieving thirty-something woman wrote about her beliefs regarding the importance of learning mathematics.

> I think it is important for everyone to learn mathematics. A person, whether they realize it or not, uses some kind of mathematics everyday. I believe it is a very empowering subject and one that has helped me greatly in my macroeconomics class. I am required to take this class before I can proceed to the next level math class. The second reason for taking this class is that I have struggled with math all of my life. It is not a subject that has come very easy to me. I am an "older" returning student with a better understanding of what it means to have an education and greater appreciation to have the opportunity to come back and finish.

Her belief in the intrinsic importance and empowerment of understanding mathematics provided strong motivation to study mathematics.

A late twenties high-achieving Hispanic woman, who was the first of her family to attend college, wrote about the importance and relevance of mathematics and her efficacy in learning mathematics. She wrote,

> I didn't think math was important when I was in high school, but I have changed my mind since then. It is now important to me because it will help me get ahead in my career. I am confident in learning math because there is help for me when I need it. I can get help from my teacher or in the tutoring lab. I also feel I am more focused now, more than in high school. I am determined to do well in math. It takes a lot of practice and willingness to learn. It is so easy to just give up when it gets hard, but as long as I keep focused and I am willing to pass this class, I will not give up.

When she was in high school, she did not think mathematics was important. Sometime after high school, though, she constructed beliefs that learning mathematics would benefit her, giving her reasons to strive for high achievement. Her focus and determination followed from her newly constructed beliefs that resources existed to support learning of mathematics.

One of Mary's students, writing his beliefs about mathematics, wrote in his learning journal, "mathematics is a process, practice, the way for the better life." He also wrote that his emotions about learning math include, "fear of not to understand the subject; terminate math and concentrate to the other subject; fear if I can make it without mathematics." He said that he feared for his future success if he did not learn mathematics. This student believed, "that success in

math indicates success in other subjects; ability to handle situations; ability to stay long in solving problems of other subjects." He wrote of a belief that learning mathematics connected to learning other subjects and ability to cope with life situations giving him a reason to strive to achieve. Mary, by the way, observed, "the majority say the reason they are here is because they need to improve their life."

An international African-American high-achiever explained his attitudes and beliefs about the mathematical importance and relevance when he wrote in his journal,

> It will always be a helpful tool in life. No matter what, you'll always encounter some form of mathematics. Mathematics helps develop our thinking and I believe makes us a better person. It also serves as a universal language. Meaning anywhere you go, in the world, it's always the same. It makes me feel smart and intellectual and it works up my brain. It will be of great value to me in my future aspiration and in life as general. It also helps in the way you think. For instance you tend to think faster and smarter. In other words without maths, I would feel incomplete. Plus it plays an important role in my future.

Describing his emotions, he continued, "Feeling bad and loosing my self-confidence whenever I don't understand a problem or topic in math. It makes me so weak and mad, and if I finally solve that problem or topic, I feel like I have just overcome a very big obstacle in my life." He believed that mathematics was very

important to learn and use, but his emotions included anger to the point of weakness when he failed to understand.

Determination or efficacy

A high achieving young man wrote about his emotions and attitudes, "Some of my emotions about learning math include: with math comes anxiety, frustration, determination, and a feeling of accomplishment all rolled into one equation." Determination was a common idea that students raised in their speech and writings about attitudes and emotions. A thirty-something woman who was a business owner and mother of a teen-ager also wrote about determination intermingled with emotions and beliefs when she wrote.

> It is frightening because I feel I have a weak foundation. Most people shy away from mathematics in general. It is a challenge and I always believed I could do anything I set my mind to do. It is recommended for the major I have chosen (architecture). It has always been difficult but now I realize the reason was a poor foundation. I believe the problem solving techniques can be applicable for various situations in life. I was reluctant at first because I was not confident with my abilities and feel that my memory is weak.

She described the emotion of fear and the belief that she could do what she determined to do. She explained her belief that her foundation had been weak and that her initial attitude had been lack of confidence in her abilities. While determination was expressed by many participants in this study it was quite common among high achievers.

A high achieving mother with mathematics anxiety explained her efficacy attitudes when she wrote in her learning journal, "Some of my thoughts on learning mathematics are getting better as time goes on. Now I know if I just keep up with the studying I can succeed. Now I look forward to future math classes not dreading them." Like many students, she mentioned attitudes of growing efficacy and determination.

Ley and Young (1998) reported that supporting motivational attitudes and behaviors among developmental learners was critical. They reminded us that many developmental learners overcome severe personal and academic hardships to seek educations. Noddings (1997) expressed an agreement with the realization that students' feelings are very important when she explained that should she teach high school mathematics again, respect for students' feelings would be an important concern.

Ma (1997) investigated the relationship between perceived importance, difficulty, and enjoyment in learning mathematics and mathematical achievement. Her study found that enjoyment of mathematics did not lessen the perceived difficulty in learning mathematics. Ma's study further suggested that low achieving students were more apt to ascribe high importance to learning mathematics. Lastly, Ma found that high achievers found more enjoyment in doing mathematics.

Life circumstances

Numerous factors influenced student motivation to learn developmental mathematics. While some of these were academic or affective, many factors concerned life circumstances.

Low Achievers on Life Circumstances

Several low achievers wrote that overwork hampered their academic progress. One low achiever wrote, "The only other factor that keeps me from investing a great deal in math is that at the moment I work two jobs. So there are times that I don't want to deal with any school work and just sit in front of the TV." She was attributing her lack of effort in learning developmental mathematics to holding two jobs and having no energy left for learning. Another student, who eventually earned a D in the course, came into the developmental course with a low-level knowledge of mathematics and wrote, "I work full time and have a lot of over time." He placed a higher priority on working long hours than on learning mathematics.

Another low achiever wrote, "I have 2 young children and as a single mother; my family required most of my time as well as my energy. My only

time to study is late at night when they are asleep." She attributed her lack of effort to being a single mother with two young children and inadequate time and energy for her education.

A young Hispanic woman, who said she never studied for mathematics, wrote, "I have to take care of dad and my nicese and newphews." She attributed her lack of involvement in learning developmental mathematics to her being required to take care of family members, external, uncontrollable circumstances.

A low achieving young African-American wrote, "frustration. I am mentally ready and able to learn math. But I have no way of getting there. So I'm very frustrated about this. It's my first semester in school I'm trying to do this and I'm being held back." Her attribution for lack of success was external. She believed that lack of transportation was beyond her control and inhibiting her progress in mathematics when she was otherwise prepared to study. She explained, "I go to get help now and help until I understand. I guess now I'm really, really trying to understand this. I have more patience now with math, and now at times I enjoy it."

Other Students on Life Circumstances

One student wrote that a major problem in learning mathematics was working 12 hour work shifts while attending college. Another student from the same class wrote, "sometimes I have too much going on in my life at one time and it makes studying very difficult as my focus is divided." Mary explained that everyone in her evening class worked and most had families. She said, "they just don't have that much energy; this is a very late class." By contrast, one high achieving, twenty-something man who believed he worked too many hours wrote that, "beer, week women, roommates, more BBQ and beer, and music" interfere with mathematical studies.

An African-American man wrote, "My two children, ages 5 and 13, are my biggest responsibility. Need I say more." Having two children was a life circumstance that required much of his attention. Similarly, a thirty-something high achiever described his life circumstances when he wrote,

> The only issue for me personally is responsibilities. My desire to learn is strong, but my most important commitment is to my family. I have to provide first and then balance with school. The reality for me is late, late night study, with split work days to attend class. The reward for me is the turning 'on' of the light bulb. Learning how to solve the equations and how to apply it. Learning the language of algebra.

A thirty-something woman, writing about family issues of a different sort, wrote, "When you are served divorce papers. That tends to zone out the math brain cells." Developmental students frequently have life circumstances that prevent their having enough time or, in some instances, enough focus for mathematical activities.

Faculty participant, Helya explained, "Of course, you know that there are many different factors for a person to be motivated. Lots of factors like family, young children, changing jobs, money, all of that," and she continued, "like family problems, working 40-50 hours a week, transportation, personal problems, psychological blocks." She described some students' involvement with drugs or alcohol as a factor inhibiting learning. She said that many student choices and life circumstances were connected to students' motivations. Craig, another instructor, mentioned students with illness and sick children that interfere with learning. Smith et al. (1996) indicated that job and family economic responsibilities impacted attendance, especially among females. Smith's study also claimed that attendance impacted success and retention.

Values

Student held values influenced their motivation, especially importance, value, or usefulness that the students attributed to mathematics. In addition, values concerning work or family responsibility in contrast to values regarding education impacted both goals and motivations.

Researchers suggested that students might become more willing to involve themselves in educational activities that they valued (Deci, Vallerand, Pelletier & Ryan, 1991; Wolters & Pintrich, 1998). A young woman wrote, "Mathematics for some unknown purpose is important to learn. But as far as the real world goes, (it) lacks necessity. Maybe that's why hapless victims are forced to learn it!" She continued, "I am not confident in learning math because I get self-conscious. I start to feel I do all the problems wrong. I get confused then I get frustrated. That's when I feel like giving up." In seeming contradiction, the same young woman wrote, "I feel that mathematics is a timeless language."

Low Achievers' Values

One low achiever explained that she had had difficulty with mathematics since she was an elementary school student and she did not value mathematics as important except for basic mathematics. Another low achieving twenty-something woman wrote "I want to learn how to solve word problems and such, but all the algebra stuff is not as important." Faculty participant, Craig, gave an example of conflicted values, between materialism and education when he said,

> Now I have a student who bought a new car to come to college, then he couldn't make classes because he was working too much to pay for the car. They don't see that is self-defeating. Something is wrong with the logic and they don't know how to compromise the two.

Craig noted another conflict between material values and educational values when he recalled a discussion with a student who fell asleep in his class. "So I have a little talk with him, 'You're trying to do too much. You can't carry 12 semester hours and work 60 hours a week.'" Craig continued, "He's enjoying having that income. Although he says he needs it to stay in school, I suspect that it's providing more than minimum subsistence." Craig explained that the student was able to come to school before he was working so much.

In a similar situation a student discussed his schedule for the upcoming semester with me. He was registered for 17 semester hours and he worked 40 hours a week, even while making a D grade in his developmental mathematics course. The conflicting values that were a perceived need for full-time employment and, at once, a full-time education were not uncommon, even for low achieving students. Sometimes it took them quite some time to decide which was most important; usually it was not learning mathematics.

Other Students' Values

Many students mentioned a value for mathematics for its expected usefulness. A young man described his lack of understanding of the value of mathematics, "polynomials, algebraic equations, etc really have no use in real life. It is [as] if they were created for theory and keep board people occupied.

But on the other hand, I like learning about them and I know they must have a place somewhere." By contrast another young man in the same class explained, "It's important in everyday use. Knowing can also boost your self-esteem, therefore improving a person's life. Math will also be very important in my future job and will definitely add to the furtherment of a career."

A high achieving, young Hispanic woman expressed her value for mathematics by writing,

> One thought about learning math is everyone, needs to know how to do it. I also think that math plays an important role in all of our everyday lives. My attitudes are very positive; I enjoy it. I love being challenged and when I learn new material in math I like it.

This student believed that mathematics was valuable in everyday life, she had positive attitudes and enjoyed learning mathematics.

Impact of instructors

Both the students and instructors in this study said that the instructors' attitudes, actions, words, and explanations influenced student motivation to learn developmental mathematics. One student wrote,

> I am not a real fan of algebra or math at all, but I will take the time to learn it. I guess I enjoy it when I understand it, which sounds funny, but I

> am sure I am not the only one that feels this way. I think your professor has an incredible impact on the student's performance and like for math.

Teacher's Respect for Students

A struggling African-American student in Mary's class explained that she wanted to maintain Mary's high regard for her when she wrote,

> I feel involved in learning in math class when I'm allowed to ask questions about a problem and not feel like my professor is going to think less of me because I don't know what's being done on a math problem. Math is the subject that I dislike the most, but I want to learn as much as I can. I also want my professor to know that, I really like the way she teaches math.

This student desired Mary's respect even though she did not like mathematics. A twenty-something woman described the importance of teachers' explanations and respect for students in a similar way, "I appreciate it that he wants to really make sure we are all understanding. Also the way he words things so that we don't feel stupid when we don't get it." Helya ascribed inherent dignity to students when she said, "respect them regardless of their abilities in class; I never ever responded negatively to a question even if one of them might think it was a stupid question." Helya realized that her words and manners influenced the students' motivation to learn.

A Teacher's Dedicated Human Relationship with Students

Mary believed that her expressed concern influenced student motivation. One of Mary's thirty-something successful students wrote, "She really cares about her students and always takes the extra steps to ensure their success." Another student described Mary's caring style when she wrote,

> She genuinely cares about her students. If I would have had her for a teacher at the beginning of my math life, I feel I would not be in developmental classes. This is my second course with her. I drive (a long way) to attend her class. I intend to follow her as long as I can. I fear the day that I have to adopt a different teacher. I can only hope that my next teacher will be as caring.

Another of Mary's students wrote, "I feel involved in learning in math class when my professor, looks at me to make sure I'm following up with the topic and that I understand it. I also feel involved when I ask questions." Another of Mary's female twenty-something, 'B' students wrote, "I do believe that you must like and trust your professor to achieve at your fullest extent." A positive relationship with the instructor was identified by many students as being important to persistence and issues of affect. These faculty and student perceptions were echoed by Greeno (1991) who wrote, "teachers also need the ability to cause students to want to participate in the tour" (p. 198), that is, the tour of learning mathematics. Ferrari and Mahalingam (1998) discussed "caring

pedagogy", one characterized by instructors' concern for students. The theme of the importance of teacher's attitudes, actions, words, relationships with students, and the value of clear explanations was evident in both student and faculty communications.

Teachers' Explanations

Helya explained that teacher's explanations were very important to all groups of students. She said, "It really makes a big difference how we explain a topic." Especially in lower level courses, Helya believed that students understood the concepts, learned, did the problems, and their motivational level increased when the language was simple and easy to understand.

One low-achieving student wrote, "Lecture math classes, where it is purely lecture are frustrating because you don't get to test out your abilities on your own in class before your sent home with your homework assignments." Greeno (1991), as if anticipating these frustrations, described an effective instructor as one who was sensitive to knowledge the student already had and helped connect new knowledge to existing knowledge by providing engaging productive tasks to help beginners turn errors into learning.

Helya and Mary talked more about the belief that their attitudes, actions, words, and explanations influenced student motivation to learn than the other

instructors interviewed. Mary also explained that her actions and words concerning study skills influenced student motivation. Researchers indicated that teachers allowing choice and giving positive feedback that acknowledge competence and efficacy support self-determined learning (Deci, Vallerand, Pelletier & Ryan, 1991; Pintrich & Schunk, 1996). One student wrote, "I like it when my teacher tells me that I'm a good student and that I can make an A. That motivates me."

Middleton & Spanias (1999) explained that teachers do influence student motivation, and that anxious students, in particular, need teachers who are patient, encouraging, and supportive. Many students attribute their strong feelings about mathematics, both good and bad, to a single teacher. Less frequently they attribute their feelings to more than one teacher.

Instructors contrast older students and younger students

Instructors believe that there are great differences between the motivations of older, returning students and younger, first time students. Craig described this difference when he said, "A lot of the younger students really are not mature enough to appreciate the opportunity just yet. They may be still living off their parents. Some of them just don't take much of life seriously yet." He continued, "They are still looking at themselves as children rather than adults,

I'm sure they don't want to be called children and wouldn't agree with that assessment; in terms of how they accept responsibility that's still the level they are operating on."

Younger students

A low achieving young woman explained her perspective when she wrote "usually when it comes to math, I don't try very hard. I am hesistant to learn math. Ever since I was very young, I've always had a problem with learning math material." This student worked as a waitress and wrote that eventually she would like to be able to do her own taxes, help her children with homework, and learn college algebra. She wrote that she was not confident in mathematics because she did not do well on tests and she believed that she had both mathematics anxiety and test anxiety. She believed that mathematics was important but she dreaded moving forward, although once she understood the content her feelings were more positive. Another low achieving, young woman with mathematics anxiety wrote,

> I feel scared at times because I'm not sure what to expect. It takes me a while to catch on. Well to be honest the only reason that I take math is because I have to. Now that I know I can do it by working hard I really want to try. If I know I can do something I want to get better at it. I can't really see that far in the future that I will need algebra for everyday life. Some math is required but not all! I am not very confident in learning math because I have never been any good at it. And it's very hard for me

> to learn. I am building my confidence but it's hard I'm trying to get better but it's difficult. Attitudes about learning math are Negative! All through four years of high school I had one good math teacher. The rest I did not relate to so I didn't understand it. At first I hated math but now I am trying much harder to understand it, and by practicing I am getting a little better with time.

She was taking developmental mathematics because she was required to take it, although she did not think she would use mathematics. She was fearful, unsure of herself, and lacked confidence. She did not believe that she had been successful in learning mathematics in the past, partially because she did not relate to three of her high school mathematics teachers so she did not understand mathematics with them. She recognized her earlier negative attitudes and now wanted to change them.

Older, returning students

Craig said of his older returning students,

> I think older students take their time more seriously sort of out of necessity. They generally are working and many have family responsibilities. If they are taking hours away to go to school, they want them to count. So they take it seriously, in terms of getting to class; also in terms of doing the outside work that has to be done.

A returning student, who wanted to get back into school described his desire for knowledge when he wrote,

> A natural eager thirst that can only be quenched by knowledge. It has been a while since I have been in school, so I am taking this particular course to kick start my brain. I also plan on pursuing a career in finance so I think it will come in handy; mathematics = power to create & equate

Another thirty-something man, who described the understanding of his need for knowledge of mathematics to become more competent, wrote,

> Math is important, very important. When you are younger you don't see the purpose, but as you live some life, the need to apply the knowledge becomes obvious. Math is all around us in various degrees. It is frustrating not being able to approach a problem with a lack of ability/ knowledge. Being self-sufficient is important to me and that comes through knowledge.

Another returning student explained his growing confidence in learning mathematics and his efficacy even though he realized that some others learned mathematics more easily than he did when he wrote,

> Making an "A" in my previous math class last semester has really built-up my confidence level towards math. I worked very hard at studying and it really paid-off. For the first time taking math, I feel as though I can really complete all of the levels of required math classes and be really proud of myself. Sometimes, I feel frustrated when things do not come as easy as for others. But, when I am feeling overwhelmed like that, I practice as many problems as I can until I feel more comfortable. I have learned the best way to handle stressful situations is to face them head on. Procrastination only makes it worse.

A thirty-something Hispanic male student expressed a mature confidence when he wrote, "(Math) was always hard and difficult, but now that I'm older, being intimidated by math is no longer true."

Another motivation of older students, Helya noted, was "if they have kids in middle school is when they see that they are able to help their children when it comes to math." She described one student who was "so excited" to help because her son liked the way she helped him understand.

Contrasting younger and older students Mac said, "a lot of (younger students) in terms of motivation seem to me they are just coming out of high school; they seem aimless...they really don't know why they are here." Of older students he said, "they have drive; they have a need to get a degree; they tend to be very well motivated."

Mary described differences between younger and older students when she said,

> I have often felt like the younger students, the ones who can take classes in the day, morning, early afternoon, because they are not working have a tendency to view the developmental mathematics probably as not important to them as the older students who have been away from school; who are paying their own tuition and having to struggle. I have often felt that they (younger students) didn't view it as being valuable.

Helya summarized differences between returning and younger students as,

> The returning students know why they are going to school. They are very determined. They know what they want to do. They tell me that they have done minimum wage jobs for years. They are sure that the school is what they want to do. As opposed to the younger students, the reason they are here may be the force of their parents ... I've had younger students who have been very motivated; most of them are not.

With certain exceptions, the instructors seemed convinced that motivations of younger and older students are different. These instructors impressions seemed in accord with Donohue and Wong (1997) who found that traditional and non-traditional university students had differed with regard to satisfaction with college and their achievement motivations.

Summary

Developmental mathematics was required for most of these mathematics students, yet many expressed motivations other than the extrinsic course requirement. Once enrolled in the course, the students clearly explained and wrote that understanding, affective aspects, goals, and teacher relationships and explanations influenced their motivation to learn developmental mathematics.

Even more than the mathematics requirement, in their speech and writings, the students expressed concern for understanding, attitudes of confidence and determination, perceived relevancy beliefs, teacher explanations, enjoyment, challenge, and frustration.

CHAPTER 6. IMPLICATIONS

The outcomes of my research contribute to the development of a comprehensive, accurate framework for describing and understanding motivation among developmental mathematics students at the post-secondary level. Moreover, improved understanding of the motivations of developmental mathematics students, properly accounted for, can contribute to implementation of learning activities, classroom structures, and teacher attitudes and behaviors that facilitate increased learning among developmental mathematics students.

Though the higher education system was originally designed to facilitate education of young adults many mature adults use community colleges to refresh, enhance, and redirect their skills and knowledge. This is consistent with Donohue and Wong's (1997) study that suggested that since older students continue to constitute a larger part of the higher education student body, it is important to develop more understanding of their unique goals and needs in the higher educational system. The faculty interviews in this study indicated significant differences between the motivation of younger and older students.

My data indicated that most students who eventually earned low grades or withdrew expressed perceptions that they faced barriers to success in learning

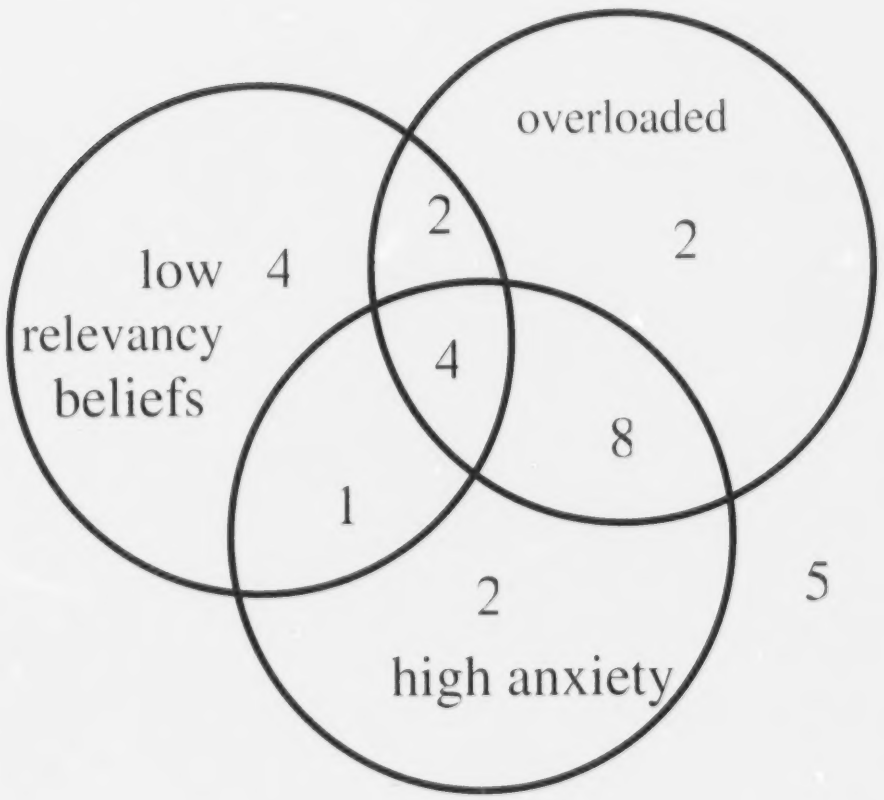
mathematics which fell into three overlapping groups. These groups of perceived barriers were 1) not perceiving the relevance of mathematics to their personal lives and career goals, 2) being burdened with anxieties and fears from past experiences in attempting to learn mathematics, and 3) believing they were overloaded with work hours, family responsibilities, or other courses. The students in group 3 expressed perceptions that the demands of career, family, and/or additional courses were more than could allow for adequate preparation for mathematics. Across the groups, I analyzed the journals and interviews of low achieving students and found most low achievers fit into the categories of high anxiety; low relevancy beliefs; or overloaded with work, family, or other academic responsibilities or some combination of these.

Many low achieving students who were anxious about mathematics believed they were overloaded as well. Further, several students who were anxious and overloaded expressed low relevancy beliefs. These three groupings may describe perceived barriers to success for some of these low achieving students. The low relevancy beliefs and high anxiety posed affective issues for the student.

Table 1 Perceptions of Possible Barriers to Success in Low Achievers

• Number Total of Students	28
	Subtotals
1. High Anxiety	15
2. Low Relevancy Beliefs	11
3. Overloaded, Jobs, Courses, or Kids	16
	Subtotals
Only High Anxiety 1.	2
Only Low Relevancy Beliefs 2.	4
Only Overloaded, Jobs, Courses, Kids 3.	2
Both Anxiety & Low Relevancy only 1. & 2.	1
Both Low Relevancy & Overloaded only 2. & 3.	2
Both Anxiety & Overloaded only 1. & 3.	8
1. & 2. & 3.	4
none of these barriers	3
none of these barriers and lazy	1
none of these and could not get to school	1

Figure 1. Perceptions of Possible Barriers to Success in Low Achievers



Authenticity of study

This study exhibited the authenticity criteria of fairness by seeking construction of meaning from students and faculty members with diverse perspectives. Educative authenticity concerns participants coming to worthwhile understandings about others by their participation in a study. Faculty participant Mary expressed evidence of educative authenticity when she stated that using the student learning journals for this study made her realize that she could understand much more about her students than she had previously. She had thought she had known her students very well before she used the student learning journals. She said that she learned so much more about her students by reading their student learning journals that she planned to use the learning journals every semester. Likewise, expressing evidence of educative authenticity, faculty participant Craig said that using the student learning journals became a vehicle that allowed him to show more care for his students, because he knew the students better.

Catalytic authenticity concerns decisions and action facilitated by constructions of meaning resulting from a study. Evidence of catalytic authenticity was exhibited when faculty participant Margaret co-presented with me on the topic of motivation in developmental mathematics students at the

American Mathematical Association of Two Year Colleges Annual Meeting after she used student journals and participated in an interview for this study.

Tactical authenticity refers to a new or greater capacity to act. Now, I matter-of-factly implement learning activities and classroom structures in ways that direct students' attention to the value and meaning of their understanding mathematics and to their task-focused and extrinsic goals such as desire for knowledge, careers, and education. While I have always supported students' efforts, attitudes, emotions, and beliefs, this study lead me to new principled activities to better serve the students' needs. For example, now after tests I have students come to my office to pick up graded tests so I can interact with them individually about their understanding, attitudes, emotions, beliefs, efforts, or other life circumstances that may influence higher achievement. Now, in every class I mention the connections of the mathematical thinking, concepts, or skills to outside of school experiences to support beliefs concerning the relevance of learning mathematics. I support students' confidence in learning and their determination by consistently directing attention to their progress and the value of their efforts. During class I model and discuss the enjoyment of mathematical problem solving and suggest that it bolsters confidence and enhances their motivation for future learning. All of these actions are in addition to careful lesson preparation with thought given to thorough explanation of mathematical

principles, to showing great concern and respect for students, and considerate advising of anxious students.

Conclusions

Motivation to learn developmental mathematics is a complex area for investigation because of the diversity of the student population, the numerous factors impacting motivation to learn, and the difficulty of collecting meaningful, authentic data. The lack of a single widely accepted framework for the study of achievement motivation makes investigation challenging because there are so many ways to consider achievement motivation.

This study began as an effort to better describe achievement motivation. By its conclusion this study had some additional benefits. Hiebert and Carpenter (1992) recommended investigation in classroom settings to reveal students' and teachers' thinking as it changes over time. This study contributed "to our understanding of students' and teachers' understanding...that reveals students' and teachers' thinking as it occurs in classroom settings and as it changes over the course of instruction" (p.92). The students very clearly expressed their perceptions that their understanding enhanced their motivation to learn as they progressed in developmental mathematics. There was no stem in the student learning journals to prompt the students that understanding might impact motivation, yet students mentioned understanding more than any other coded

idea. This close connection expressed between perceived understanding and motivation to learn developmental mathematics emerged as the study progressed. This connection was not an idea that I had expected based on knowledge of motivation theories alone. Rather it was the vital connection that students expressed between perceived understanding and motivation that is the breakthrough in this study. The entwining of motivation to learn mathematics with perceived understanding, attitudes, beliefs, and emotions was extremely deep. This finding suggested that the NCTM's *Principles and Standards for School Mathematics* (2000) recommendation that mathematics should be learned with understanding is in agreement with developmental mathematics students' perceptions. This finding further suggested that the *Principles and Standards* (2000) recommendation that mathematics assessment, "should focus on students' understanding as well as their procedural skills" (p. 23) was much needed by these developmental mathematics students during their mathematics education. The findings of this study align with the *Principles and Standards* (2000) assertion that when students struggle to learn and understand mathematics the accomplishment they feel may lead to a willingness to continue involving themselves in mathematics learning (p.21). The findings align with Bandura's (1989) self-efficacy theory in which a person's beliefs about future successes are an important component of effort and persistence in motivation.

This study suggested that students were not limited to one of the task-focused or relative ability goal orientations and agrees with Middleton and Midgley's (1997) explanation that students were not limited to one goal orientation. Developmental mathematics students expressed having several goal orientations throughout a semester and may have several goal orientations at any one moment. Some students exhibited several of the orientations of task-focused goals, relative ability goals, performance avoidance goals, or extrinsic goals within the same semester influencing their reasons for learning developmental mathematics. Only two students described themselves as lazy, having work avoidant goals.

Stepek et al. (1998) indicated in studies of younger students that the affective aspects of motivation were very powerful descriptors of motivation that had received little study. The affective aspects were powerful descriptors of motivation in many of these developmental mathematics students in a community college. This finding provides more support to Stepek's et al. (1998) description of the importance of the affective aspects of achievement motivation. This dissertation explored possible perceived affective barriers to success of developmental mathematics students as called for by Higbee and Dwinell (1996) who proposed an investigation of affective variables and their impact on high-

risk developmental college students. This study found that many of the affective responses in developmental mathematics students were very intense. For instance, a big perceived affective barrier that was commonly expressed, along with mathematics anxiety and lack of relevancy beliefs, was fear, "Fear of failure, of feeling stupid because I don't understand." McLeod (1992) had suggested the need to determine whether the affective responses were intense or less intense in motivation in mathematics learning. There can be no doubt about the intensity of the emotion of the student who wrote, "My emotion about learning math is fear. Math has a way of conquering me sometimes."

Limitations

There was no intention that this study should be generalized beyond its context. Any transferability or applicability to other contexts must be decided by the knowledgeable reader who recognizes a similar context based upon the deep description. This study was not designed to categorize gender, age, or ethnic differences among student responses, but to state them when they were available.

This study investigated the achievement motivation for learning mathematics of more than 100 developmental mathematics students at a community college with data collection over several semesters. Only 28 low achievers with eventual course grades of D, F, or W allowed interviews or

allowed their student learning journals to be included in the data collection. None of the students interviewed participated in the second or third forms of member checking to check that the ideas written expressed their true views although I requested member checking. All students participated in the first form of member checking; they confirmed their main ideas as I restated them during the interviews.

The participants of this study were limited to the students and faculty of one large multi-campus community college covering a large urban and suburban area. The college prohibited qualitative interviews with students during the first year of data collection. The Departmental Research Committee prohibited me from requiring students to write in student learning journals in my classes during data collection.

The primary data generation was self-report in student learning journals throughout a given semester. The secondary data generation was student and faculty interviews. The data consisted of perceptions of students about themselves based on their experiences, as well as faculty perceptions of motivation in developmental mathematics students. While there are more elaborate and painstaking ways to gather data, I strongly believe that the student learning journals and interviews were appropriate and that the students did

accurately portray their genuine beliefs and concerns in those journals and interviews.

Further Study

I recommend more investigation using naturalistic research of the relationship between understanding mathematics and motivation to learn developmental mathematics especially among low achieving students. I recommend more investigation of the relationship between understanding mathematics and beliefs concerning the relevancy or usefulness of mathematics especially among low achieving developmental mathematics students.

Other findings that might be a basis for further study include investigation of low achieving developmental mathematics students with mathematics anxiety, low relevancy beliefs, and/or overloaded with work, family responsibilities, or other academic courses. A similar investigation would be a study of developmental mathematics students, who have had these attributes in the past, but have overcome these barriers. The students might be able to describe some factors that supported their overcoming the barriers. Students in this study described factors of maturity, patient teachers, current success, and developing understanding as factors that supported higher motivation.

Student motivation is of interest to many developmental mathematics educators, who deal with this diverse student population. Many developmental mathematics students have experienced failure and frustration in learning mathematics in the past, but now the cycle must change because of the needs of society. Enhancing students' motivation is one key to helping developmental mathematics students succeed. Many of these students want understanding because they believe in mathematics, understanding is one key to motivation. Many students agree with King Solomon's admonition from Proverbs 3:7, "And with all your acquiring, get understanding."

Appendix

Person as Instrument Statement

My grandparents were independent settlers and farmers who worked hard to change a western frontier into a farming community. My father was the first of the family to attend college and attain a college degree soon after World War II. My extended family always expressed confidence and appreciation for my abilities and for me. The admiration and love they had for me was a strong foundation for my development. My parents expected all three of their children to go to college and two of us finished a degree.

Motivation to learn mathematics results from many experiences throughout life. My motivation to learn mathematics involved family interactions that were different from many families in the United States. My father helped me with my mathematics homework, which is very common among many families. My mother expected me to be successful in mathematics, as well as in my other course work. Many mothers in the United States do not expect their daughters to be successful in mathematics, and they give the daughters permission not to exert much effort in learning mathematics. Mothers frequently tell daughters that because they had a hard time learning mathematics and did not like it, daughters manage without mathematics.

While I was growing up we lived in four states and 6 cities. During the Viet Nam War Era, I married, dropped out of college, and lived in another state, and Thailand for two years. The dropping out of college for a while is an experience that many of the students in developmental mathematics have in common with me. Many of them are in and out, and back in, post-secondary education. I enjoyed investigating the Thai culture while I lived in Thailand. I learned to speak simple Thai and studied Thai classical dance. I traveled to two

other nearby Asian countries. I taught at a private school and for the U.S. Army in Thailand. Numerous students in developmental mathematics are from various cultures from around the world. I have some personal experience with how confusing another culture can seem when one is a stranger to it.

I returned to college and completed a bachelor's degree in mathematics and a master's degree in teaching mathematics. I lived in two additional states and taught middle school. I taught GED and community college mathematics courses. This teaching was my dream career although I enjoyed public school teaching. I taught at two community colleges in two states before moving back to Texas and beginning college teaching here. In addition to my community college instruction, I taught one year at a small liberal arts university. My teaching experiences include two and a half years in public education at the middle school level, fifteen years adjunct at community colleges and one liberal arts university, and six years full-time at the community college level. I enrolled in graduate school to pursue a Ph.D. in mathematics education seven years ago. Many of the developmental mathematics students share my experience of returning to post-secondary education after many life experiences.

I began making presentations at national mathematics education conferences five and a half years ago. This enabled me to have personal lines of communication with other community college faculty members around the United States. We regularly discussed our students and their learning and motivations.

My students regularly encourage me to continue teaching because they say that their lives and educational experiences are better because they study with me. I received the annual teaching excellence award from my college recently, which my students had nominated me for.

Time management and energy use are big challenges for me. The same is true for many developmental mathematics students. I am interested in many things and I have many opportunities and pressures for leadership in my educational institution.

A value that I hold that is related to the topic and informants that I investigated is that the opportunity for education that we enjoy currently in the United States is rare and precious in the rest of the world. Most societies do not offer second and third opportunities for formal education like we have in the U.S. While we have the opportunity we must grasp it if we want it. Since my topic concerns motivation to learn, I must be careful not to confuse my investigation of motivation in developmental mathematics students with my own strong values concerning the topic. I must be careful not to confuse my involvement in motivating students with my study of students' motivations to learn developmental mathematics.

My mathematics teacher my junior and senior years of high school was a strong motivator for me. He was way ahead of his time in use of constructivism in the mathematics classroom. He realized the value of the need for filia relationships among students in constructing meaning in mathematics. This value was very important to me at that time and therefore was a strong motivator for me. I like working in small groups in the classroom and problem solving together.

When I went to college as an undergraduate there were very few developmental mathematics programs in colleges and universities. Most students who would have needed a developmental mathematics program did not go to college. Graduate students taught the few students who needed remedial mathematics. The program and the teaching got very little attention.

I relate to the students because I understand that some things are difficult for me to learn just as mathematics is difficult for many of them. In particular, writing is usually a struggle for me and it has been since I can remember. I used to hate writing and I chose a college major that required almost no writing, just as some of the developmental mathematics students want to chose a major that requires no mathematics.

I also relate to the developmental student population because learning mathematics was not easy for either my son or my daughter. My daughter changed her college major when she studied calculus as many female students do. My son put off taking college algebra until his fifth year of college.

I hope that some of the outcomes of my research will contribute to the development of a framework for describing and understanding motivation among developmental mathematics students. I hope that increased understanding of motivation of developmental mathematics students, can contribute to implementation of learning activities, classroom structures, and teacher attitudes and behaviors which will facilitate increased learning among developmental mathematics students.

My understanding of reality is that of perceived reality. I believe there is a reality out there. I do not believe that one person can know all of reality clearly in this life. The researcher co-constructs understanding with the informants. Reality described in social and educational research is regularly changing as our society and culture changes.

Sample of Each Type of Data Collected

Interview Transcription Sample from an Instructor

She is learning to like the feeling gets when she can understand something and can work the problem. she said in her journal she was a terrible math student. This is her perspective after many years she been working and now she's back in school and finding it enjoyable. but her's was different from everyone else's. The majority are saying the only reason to be here is to improve their life. I think that this is their way to get their degree, to get a better job, that kind thing.

Nancy—Have you had any other examples of students who came to the realization that there was enjoyment in the problem solving? Or in the study of mathematics?

I'm only talking about this one class. There is another young man, I think he is from Africa. he has a very heavy accent and he has a very unusual last name. he stands out in my mind that he really enjoys understanding something and being able to find the solution and being able to get a problem right. the other thing he said, this is something that I had suspected in developmental students. but not always really proved it. but what he likes is when I show more than one way to solve the problem. he really likes that. I had suspected the developmental students liked having me show more than one way of solving the problem. none ever said it. I don't think I ever even put it in words. I will say, here is one way to work this problem. Are there other ways? and we will talk about more than one way to work out the problem. I point out if you know more than one way you can check your work. do it one way in the

testing center and see if it works by the other method. He actually put that into works. I have suspected that, I never had anyone put it in words.

Nancy—Do you have any examples from any of your developmental classes about knowledge of any students in which you believe that the students were studying developmental mathematics because they wanted to improve their lives?

I have suspected it. It has never been put in writing. Thank you very much for the journals. I want to use them from now on. it is a real eye opening experience. After I had been reading the ele algebra journals, I was asking my prealgebra classes, why are you in here? why are taking these classes? It's a very young group, a very very young group. It's in the day, not all of them work. most are just students here. I have some students in there that are very loud and they talk. I don't have to motivate them to talk at all, and the majority were saying they are here because their parents are making them come here , they did not really see pre-algebra as anyway to improve their life. I said, Why are you here? you are an adult, you make choices. what are your goals? They say, "oh I'm because my parents want me to be in college." It's so different from the evening class of adults who have already been out there. Who are here because they see this what they are going to do to improve their life. I also have been reading their rating; you know how they rate the 1- 6 what you want with your mathematics. I had thought that a lot of people would want to help their kids with math. That's like the last thing on their mind. They rate higher other things like satisfaction they're getting like the understanding that they are getting that they didn't have before. a lot of them express regrets over high school. a lot of them have expressed frustration over having to be in development because they feel like they wasted their high school time. had they been paying more attention, they would not have to be in this class. I have one young man he's

married; he's talked about his 9yr old daughter. he works full time. He's not keeping a journal. He's making a B in the class. he is very interested. he asks questions. I asked him why he's not turning in the journal for extra credit. finally he said that this class doesn't really count. so we got in the whole argument about developmental vs. college level and why are here. he says no it's not going to hurt my GPA. it's not going to count. I started asking him "what degree are you working on" he wants to get into business. I said "you're talking business calculus" He says " oh no, no, it doesn't count." he is not seeing the importance, but he is doing well. Perhaps he's frustrated by having to start so far down.

Student Learning Journal Sample

*11-4 Some of my beliefs about learning mathematics include.... mathematics is complicated. Mathematics is time consuming and sometimes hard to prepare for.

*11-4 Some of my emotions about learning math include.... frustration with word problems, confusion with math techniques sometimes

*10- 28 My motivations to learn mathematics include ...To increase my understanding of math. My motivation to take this math course is to be able to take a higher level of mathematics like trigonometry.

*11-4 Why learning math is important to me ...It is important to me because I feel math is a very valuable skill to have and master.

*I am confident in learning math because ....each time I do my homework I learn more or *I am not confident in learning math because 10-28 I am more confident in math because I have finally begun to master word problems.

*10-28 Some of my attitudes about learning math are: at time I feel overwhelmed by homework ahead of me that needs to be done, however I am relieved to find out that as I do my homework it is really easier than what I had thought it would be.

*10-28 How did you study your math this week? I work everyday so I take naps when I can and stay up late when it quiet and my total attention is on my math homework.

*10-28Has your typical way of studying changed during the semester? Yes I go to the tutoring labs prior to a test to finish homework or get extra help on problems I have questions about.

*11-4 Have changes in way of studying math affected your attitude, emotion, or success in math? Yes (In what way, if it has? As long as I have finished homework and spent time in the math labs I feel confident each time I have a test to take.

Blank student learning journal

Weekly Mathematics Learning Journal

Name_____

Write on any topic each week using honest, direct, sincere responses.

During the semester try to write at least 2 or 3 complete sentences for each topic. Try to write or add to one topic each week. Date each entry. Use either positive or negative responses without concern for one being more acceptable than the other, instead focus on honest responses. Feel free to update your entries as your thinking progresses over the semester. Feel free to continue any responses on the back of any sheet. If you withdraw, please leave this in your professor's mailbox. The purpose of this journal is to be a line of communication with your professor and to provide data for improving instruction and curriculum in colleges. Your name will be removed from your responses before submission for data analysis.

Turn in every other week or as your professor asks.

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dates

____ Some of my beliefs about learning mathematics include

dates

_____ Some of my emotions about learning math include

dates

_____ My motivations to learn mathematics include (reason I take mathematics)

dates

_____ Why learning math is important to me

Or why learning math is not important to me

dates

_____ I am confident in learning math because

Or I am not confident in learning math because

dates

_____ Some of my attitudes about learning math are

dates

_____ Estimate the total number of times you sought help with learning math during this semester from your professor _____; from the learning lab____; from other students_____; other_____.

dates

_____ How did you study your math this week?

dates

_____ Has your typical way of studying changed during the semester?_____

In what ways, if it has?

__Have changes in your ways of studying math affected your attitudes, emotions, or success in math?_____ In what ways, if it has?

dates

____I expect the effort and time I invest in this math course will result in a letter grade of _____

dates

____ For my future goals the aspect of mathematics in this course that I believe will be most important to me (please number from 1-6 with 1 being most important to you)

_____ ability to help children with homework

_____ competence in math to support study of more math

_____ competence in math to gain understanding, insight, or skill

_____ competence in math to support learning in other subjects such as sciences, economics, technology, computer science, engineering

_____ competence in math to support my career plans

_____ competence in math to gain favorable judgments of my ability from others

_____ competence in math to support citizenship (like understanding taxes, environmental issues, population growth, & city planning)

_____ other, please list

dates

___The focus of this course concerning what is most valuable to me has to do with (please number from 1-5 with 1 being most valuable to you.)

_____problem solving

_____number sense development (like estimation & determining reasonableness of numbers in shopping, budgeting, etc.)

_____reasoning & thinking skills

_____ability to communicate using math ideas

_____competence in computation (like arithmetic procedures)

dates

____ In order to focus my attention when I study math I

dates

____ Activities, attitudes, feelings, or responsibilities that sometimes may keep me from investing the time, energy, or effort to do my very best in learning math may be (if there are any)

dates

____ If I find that my motivation to study math is lagging and I want to learn math then I

dates

_____ Some of my thoughts on learning mathematics are

dates

_____If I feel overly anxious about math tests after I have read the text and done the homework then I

dates

_____ I learn best when my math professor

dates

_____ I feel involved in learning in math class when

dates

_____ I want my professor to know

At this time I do not foresee that this information will be used but it may be useful in this study in the future.

student characteristics:

check any that apply

age group ___18-21 ___22-27 ___28-40 ___over 40 yrs

___male ___female ___Hispanic ___African-American

___Anglo___Asian ___other ethnic group, specify_____

___special needs ___math anxiety ___test anxiety __irregular attendance and little homework _____excessive work hours for semester hours attempted _____extra family responsibilities

Thank you for your participation.

Sincerely, Nancy C. Miller Phone 223-4864

Member Checking Sample

Initial Summary for Helya for Novemeber 2, 1998 interview

Please help me to be sure that I understand your meanings by making suggestions for changes so that this summary better reflects your ideas about motivation in the developmental mathematics students.

Please write a ! for very important idea , or a * for yes that's my idea, or a # for change the idea to_____. Thanks.

Some students begin to enjoy math after they begin to learn in a respectful, accepting environment and they can see they are progressing. This progress motivates them.

Teacher showing respect to students may cause student motivation to go up.

Growing confidence may motivate students.

Having strong goals motivates students.

Realizing that they are in a class in which they can succeed motivates some students.

Interest motivates some students.

Student attitudes and anxiety impact student motivation.

Many factors which teachers cannot impact interfere with student motivation.

Thanks so much.

Yours, Nancy

Attempted member check with student sent by e-mail but there was no response

Outline sent by e-mail to member check with Evelyn Spring 2000

Main ideas concerning motivation to learn mathematics

1. Evelyn's primary goal in learning mathematics is to pass the TASP test and eventually pass College Algebra. She doesn't believe that she will need to use algebra or mathematical ways of thinking in her career or her other life activities. She does not perceive mathematics to be relevant to her life and interests. She believes that mathematics is primarily needed by engineers and doctors only.
2. She believes that she gained her disinterest and dislike for mathematics (which she really hates) from her family and from teachers in junior high school who didn't teach for understanding.
3. Frustration became an important attitude as she progressed in her study of mathematics. When she doesn't understand a subject, she doesn't like that subject.
4. Evelyn has had a number of very bad mathematics teachers. None broke it down so she could understand. She attributed some of her difficulties in learning mathematics to professors who didn't explain clearly.
5. Understanding is a major theme in mathematics learning for Evelyn. One of her beliefs is that because she didn't understand, she didn't apply herself fully. She preferred to apply her energy and time to subjects that she understood and liked.

Sample Reflexive Journal

October 21, 1998

I'm working on transcribing and making appointments for more interviews. I'm seeing Craig Thursday and Mary Friday. I summarized Craig's interview, but I can't get him on the phone to member check the summary.

Lots of reading, but my understanding of naturalistic inquiry is growing.

Next week we are planning to bring unitized, labeled transcriptions to peer debriefing to discuss with each other.

October 22, 1998

Craig has been too busy. I must member check with him and Mac tomorrow.

Tomorrow I have the appointment with Mary. The question that I'm using is Tell me about your perceptions of motivation in the developmental mathematics students. If a follow-up is needed to focus in if they don't voluntarily discuss their ideas about the under-achievers or work avoiders, then I ask more specifically about the under-achievers or work avoidant student motivation in developmental mathematics. I have asked them for e-mail communications also, but I need to be more persistent. I hope that Mary will keep a reflexive journal on the topic for the rest of the semester too. I have asked her. I mentioned to Helya that I'd like to interview her soon. She seemed receptive.

I worked this week on transcribing Mac's interview. It is time consuming, but very interesting. I really like this research.

As far as I can tell as I continue to think about world views and paradigms I believe that the perceived position best describes me. I believe that there is a reality, even though in motivation it is continuously being constructed and re-negotiated by experiences and social interactions. I can only understand another's motivation from my perspective, but it is really there.

Dr. Judi Harris made it very clear to me and to the entire naturalistic inquiry class last night that the reflexive journal is very important. I didn't realize quite how important it was before. It has to do with three fourths of the quality criteria.

October 23, 1998

Continuing on last night's topic, of the qualities for trustworthiness or authenticity.

This morning I member checked with Craig Blake. We also continued his interview. It went well. He said the summary was OK. The summary included

- older students are motivated, but sometimes don't have the hours they want
- some younger students lack maturity
- some do not see the immediate benefit or that studying math is related to their goals
- for some that math is required for their degree is enough motivation for them to succeed
- some have heavy work loads at work
- some have conflicting desires to do well in math but also other responsibilities take their time
- some have expectations of themselves that are unrealistic

Craig did say that these were his ideas about student motivation in developmental mathematics and he continued to explain.

This afternoon I interviewed Mary. Her interview was tremendous. She says that using the journals is very helpful and that she wants to continue using them.

Peer Debriefing Group Minutes Sample

Minutes for Peer Debriefing Meeting on November 16, 1998

Greetings.

We looked at Nancy's codes and discussed feedback from Dr. Harris.

Kris has 7 themes. Is this too many? Didn't Dimric have 5 themes? We will check. He aims for 3 or 4. We discuss his idea of cross-referencing between informants to determine real themes.

We discussed possible themes for Nancy's codes. She likes combining and restructuring the ones discussed earlier in the month into 4 themes based on groupings of the codes.

Kris reminded us to relate our themes to the focus of the study as Dr. Harris reminded him to do.

We discussed specifics of member checking details. We compared our member checking techniques.

We discussed group dynamics.

We discussed what we have to do to finish our studies.

The discussion of member checking came up again. We discussed the third and final type of member checking, asking the informants to read the case study. We discussed writing up the reports, including referring back from the theme section to the case studies. It will be fun to write them up.

We discussed the difficulties of implementing change in classrooms.

List of codes and definitions

1. Anxiety: free floating fears about generalities especially related to mathematics; uneasy thoughts about what may happen like possible doom; not as focused as fear; some view mathematics anxiety as resulting from low mathematics self-efficacy.
2. Desire to improve life: students want a change in the quality of life in general.
3. Family responsibilities: immediate family needs that require students' attention and time that might otherwise have been used for learning.
4. Goals: strong hopes and dreams that are being actively pursued.
5. Interests: particular student preferences or student liking something; qualitative personal preferences.
6. Needs: essentials for life; necessities; requirements for life to survive.
7. Perceived relevance: awareness of usefulness, awareness of connections to other parts of life.
8. Requirement: necessary or essential for student to continue in class or in school in order to pursue the chosen field of study or goals.
9. Returning students: students who have been out of school for several years, usually over 25 years old.
10. Rewards: return for effort; benefit; both extrinsic rewards and intrinsic satisfactions.
11. Teacher immediacy: feeling physically or psychologically close to instructor, liking the instructor or belief that the instructor knows and likes the student.
12. Teacher persuasion: trying to convince student concerning learning.
13. Values: what a person holds dear, important, meaningful, and worthwhile.

14. Work issues: conflicts with academic study time caused by job taking too much time needed for study; perception that job must take priority over academic pursuits..
15. Younger students: students who are 18-22 years old or act with similar characteristics.
16. Determination: willingness to expend effort; want to, desire to achieve, can do attitude.
17. Emotions other than anxiety: feelings with bodily involvement, affective issues; shorter term and more intense than attitudes.
18. Teacher showing respect to student: high value placed on individual students; esteem, consideration, regard for students by instructors.
19. Previous experiences: past that student brings with them to class, events of past that student perceives impact present.
20. Attitudes: longer term than emotions, fairly stable affective responses that may not have bodily component that emotions have.
21. Enjoyment: Deep sense of satisfaction; take pleasure in, liking to participate in mathematics or mathematics class.
22. Perceived progress: students ideas about advancing or developing academic achievement, gaining knowledge or new skills.
23. Teacher explanations: how the teacher explains mathematics; to make mathematics meaningful and clear.
24. Simple language: words used in mathematics instruction and how the words are put together for meaning; easy to understand words and phrases.
25. Confidence: firm beliefs and attitudes about self and abilities; assurance; belief that self can succeed at an expected level.
26. Efficacy: belief about self and confidence in abilities in a given domain that results in action and effort; the power to produce a result.

27. Extrinsic goals: active pursuit of plans to obtain particular grades, careers, degrees, or rewards for pleasing others.
28. Intrinsic motivation: reason for willingness to achieve is internal desire to know, understand, or increase ability for personal reason rather than for external reason.
29. Rewards: something received or expected to be received that self desires.
30. Importance: perception of high value.
31. Frustration: feelings resulting from expectations that cannot be met with resources as self expected them to be.
32. Challenge: situation that requires focus and concentration.
33. Work avoidant: does not exert effort to learn.
34. Satisfactions: pleasant feeling resulting from activity.
35. Ego goals: actively pursued plans to please or impress others, greater concern for self than for learning.
36. Group work: refer to working with other students.
37. Failure in past: previous experience of not meeting expectations for learning mathematics or of rewards like grades.
38. Other courses: attribution of inadequate time or energy because of other courses' requirements.
39. Understanding: process of constructing schema (internal representations of information) and connecting and organizing them.

Organization of Some Most Frequently Used Codes and Themes

Achievement Motivation

1. Attitudes
   - A. Satisfaction
   - B. Confidence
   - C. Efficacy (determination and challenge)
   - D. Enjoyment
2. Emotions
   - A. Anxiety
   - B. Frustration
   - C. Other, fear, hate
3. Beliefs
   - A. Perceived relevance (importance)
   - B. Understanding is necessary
4. Goals
   - A. Extrinsic (requirement)
   - B. Intrinsic motivation
   - C. Relative ability Ego Performance approach
   - D. Performance avoidance
   - E. Task focused Learning (Mastery) challenge
5. Other circumstances
   - A. Other courses
   - B. Family responsibilities
   - C. Work issues
6. Teacher immediacy and explanations

Bibliography

Alexander, P. A., Schallert, D. L., & Hare, V. C. (1991). Coming to terms: How researchers in learning and literacy talk about knowledge. *Review of Educational Research,* 61, 315-343.

Alley, V. M. (1995). Motivation responsibilities of students and faculty. *Research and Teaching in Developmental Education, 12 (1), 55-59.*

Ames, C. (1992). Classrooms: goals, structures, and student motivation. *Journal of Educational Psychology,* 84(3), 261-271.

American Mathematics Association of Two-Year Colleges. (1999). *Crossroads In Mathematics: Programs Reflecting the Standards.* Eds. M. Mays & D. Cohen. AMATYC: Memphis,Tn.

Bandura, A. (1998). Human agency in social cognitive theory. *American Psychologist,* 44, 1175-1184.

Bandura, A. (1991). Human agency: the rhetoric and the reality. *American Psychologist,* 46, 157-162.

Bassarear, T. (1986). Attitudes and beliefs about learning, about mathematics, and about self which most seriously undermine performance in mathematics courses. Paper presented at the Annual Conference of the New England Educational Research Organization. (Rockport, ME, April 1986).

Boylan, H. R. (1999). Exploring alternatives to remediation. *Journal of Developmental Education,* 22(3), 2-10.

Brophy, J. (1987). Synthesis of research on strategies for motivating students to learn. *Educational Leadership,* 45(2), 40-48.

Brown, C. H. (1995). Instructor concern: how important is it to remedial and developmental students. *Research and Teaching in Developmental Education, 12 (1), 5-13.*

Busald, G. (1997). Presentation at Texmatyc at the Texas Section of the Mathematics Association of America Meeting. Seguin, Tx. April 1997.

Christensen L. J. & Menzel, K. E. (1998). The linear relationship between student reports of teacher immediacy behaviors and perceptions of state motivation, and of cognitive, affective, and behavioral learning. *Communication Education*, 47, 82-90.

Christophel, D. (1990). The relationships among teacher immediacy behaviors, student motivation, and learning. *Communication Education*, 39, (4), 323-340.

Csikszentmihalyi, M. (1997). *Finding Flow: The Psychology of Engagement with Everyday Life*. New York, NY: Basic Books, HarperCollins Publishers, Inc.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: the self-determination perspective. *Educational Psychologist*, 26, 325-346.

Donohue, T. L. & Wong, E. H. (1997). Achievement motivation and college satisfaction in traditional and nontraditional students. *Education*, 118 (2), 237-243.

Edkard, J. S. (1995). Correlating attitudes and college majors among undergraduate women. Master's thesis, Chadron State College NE.

Elliot, A. J. & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: a mediational analysis. *Journal of Personality and Social Psychology*, 70 (3), 461-475.

Elliott, J. C. (1990). Affect and mathematics achievement of nontraditional college students. *Journal for Research in Mathematics Education*, 21(2) 160-165.

Erlandson, D. A., Harris, E. L., Skipper, B. L., & Allen, S. D. (1993). *Doing naturalistic inquiry: a guide to methods*. Newbury Park: Sage Publications.

Fanelli, G. C. (1977). Locus of control. In *Motivation in Education*. S. Ball (Ed). New York, NY: Academic Press.

Ferrari, M. & Mahalingam, R. (1998). Personal cognitive development and its implications for teaching and learning. *Educational Psychologist*, 33 (1), 35-44.

Frymier, A. B. & Houser, M. L. (1997). Unpublished paper.

Frymier, A. B. & Shulman, G. M. (1995). "What's in it for me?": increasing content relevance to enhance students' motivation. *Communication Education*, 44 (1), 40-50.

Fuchs, L. S., Fuchs, D., Karns, K., Hamlett, C. L., Katzaroff, M., & Dutka, S. (1997). Effects of task focused goals on low-achieving students with and without learning disabilities. *American Educational Research Journal*, 34 (3), 513-543.

Greeno, J. G. (1991). Number sense as situated knowing in a conceptual domain. *Journal for Research in Mathematics Education*, 22 (3), 170-218.

Glasser, W. (1990). *The Quality School: Managing Students Without Coercion*. New York, NY: Harper & Row, Publishers, Inc.

Graham, S., & Weiner, B. (1996). Theories and principles of motivation. In *Handbook of Educational Psychology*. Berliner & Calfee (Eds.). New York, NY: Simon & Schuster Macmillan.

Grouws, D. A. (1992). (Ed.) *Handbook of Research on Mathematics Teaching and Learning*. New York, NY: MacMillan Publishing Company.

Harris, J. (1998). Personal class explanation at the University of Texas at Austin.

Hashway, R. M., Hammond, C. J. & Rogers, P. H. (1990). Academic locus of control and the collegiate experience. *Research and Teaching in Developmental Education*, 7 (1) 45-54.

Hiebert, J. & Carpenter, T. P. (1992). Learning and teaching with understanding. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning (pp. 65-97)*. New York, NY: MacMillan Publishing Company.

Higbee, J. L. (1996). Ability, preparation, or motivation? *Research and Teaching in Developmental Education, 13 (1), 93-96.*

Hodges, R. B., Corkran, G. M., & Dochen, C. W. (1997). A state-mandated basic skills program: an interview with Kenneth H. Ashworth. *Journal of Developmental Education,* 21 (2) 20-22.

Husman, J. (1997). Personal conversation at the University of Texas at Austin on October 22.

Keller, J. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development,* 10 (3) 2-10.

Lazarick, L. (1997). Back to the basics: remedial education. *Community College Journal,* 68(2) 11-15.

Ley, K. & Young, D. B. (1998). Motivation in developmental and regular admission college students. . *Research and Teaching in Developmental Education,* 14(2) 29-38.

Lowery, B. R. & Young, D. B. (1992). Designing motivational instruction for developmental education. *Research and Teaching in Developmental Education,* 9(1) 29-44.

Ma, X. (1997). Reciprocal relationships between attitude toward mathematics and achievement in mathematics. *The Journal of Educational Research,* 90 (4), 221-229.

Manning, K. (1997). Authenticity in constructivist inquiry: methodological considerations without prescriptions. *Qualitative Inquiry,* 3 (1), 93-115.

McCabe, R. H. & Day, Jr., P. R. (1998). *Developmental Education: A Twenty-First Century Social and Economic Imperative.* The College Board: League for Innovation in the Community College.

McLeod, D. (1992). Research on affect in mathematics education: a reconceptualization. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning (pp. 575-596).* New York, NY: MacMillan Publishing Company.

Middleton, J. A. (1999). Curricular influences on the motivational beliefs and practice of two middle school mathematics teachers: a follow-up study. *Journal for Research in Mathematics Education*, 30, (3), 349-358.

Middleton, J. A. & Spanias, P. A. (1999). Motivation for achievement in mathematics: findings, generalizations, and criticisms of the research. *Journal for Research in Mathematics Education*, 30, (1), 65-88.

Middleton, M. J. & Midgley, C. (1997). Avoiding the demonstration of lack of ability: an under-explored aspect of goal theory. *Journal of Educational Psychology*, 89 (4), 710-718.

Moghaddam, F. M. (1998). *Social Psychology: Exploring Universals Across Cultures*. New York, NY: W. H. Freeman and Company.

Mullin, M. H. (1991). *Educating for the 21st century*. New York: Madison Books.

National Council of Teachers of Mathematics. (1989). *Curriculum and Evaluation Standards for School Mathematics*. Reston, Va. :Author.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA.: Author.

Newby, T. J. (1991). Classroom motivation: strategies of first-year teachers. *Journal of Educational Psychology*, 83 (2) 195-200.

Noddings, N. (1997). Must we motivate. In N. C. Burbules & D. T. Hansen (Eds.) *Teaching and Its Predicaments. (pp. 29-43)*. Boulder, Colo: Westview Press.

Nunes, T., Schlikmann, A. D. & Carraher, D. W. (1993). *Street Mathematics and School Mathematics*. Cambridge: Cambridge University Press.

Pedro, J. D., Wolleat, P., Fennema, E. & Becker, A. D. (1981). Election of high school mathematics by females and males: attributions and attitudes. *American Educational Research Journal*, 18 (2), 207-218.

Pintrich, P. R. & Schunk, D. H. (1996). *Motivation in Education*. Englewood Cliffs, NJ: Prentice-Hall.

Ponticell, J. A. & Beckett, A. M. (1997). At-risk students' perspectives on motivation. *Kappa Delta Pi Record,* 33 (4), 135-137.

Prawat, R. S. & Floden, R. E. (1994). Philosophical perspectives on constructivist views of learning. *Educational Psychology,* 29 (1), 37-48.

Preston, V. A. (1993). Emphasis on mathematical concepts and its relation to developmental mathematics students' performance, anxiety, and attitude. Unpublished Dissertation. Austin, TX: The University of Texas at Austin.

Ralph, E. G. (1998). *Motivating Teaching in Higher Education: A Manual for Faculty Development.* Stillwater, Ok: New Forums Press, Inc.

Rinne, C. H. (1998). Motivating students is a percentage game. *Phi Delta Kappan,* 79 (8), 620-628.

Ryan, A. M. & Pintrich, P. R. (1997). "Should I ask for help?" the role of motivation and attitudes in adolescents' help seeking in math class. *Journal of Educational Psychology,* 89 (2), 329-341.

Sanbormatsu, D. M., Shavitt, S. & Sherman, S. J. (1991) The role of personal relevance in the formation of distinctiveness-based illusory correlations. *Personality and Social Psychology Bulletin,* 17 (2) 124-132.

Sass, E. J. (1989) Motivation in the college classroom: what students tell us. *Teaching of Psychology,* 16(2), 86-88.

Schunk, D. (1997) Presentation at the University of Texas at Austin on October 22.

Small, R. V. & Gluck, M. (1994) The relationship of motivational conditions to effective instructional attributes: a magnitude scaling approach. *Educational Technology,* 34 (8), 33-40.

Smith, D., O'Hear, M., Baden, W., Hayden, D. & Gorham, D. (1996). Factors influencing success in developmental math: an observational study. *Research and Teaching in Developmental Education,* 13 (1), 33-43.

Smith, J. O. & Price, R. A. (1996). Attribution theory and developmental students as passive learners. *Journal of Developmental Education*, 19 (3), 2-4, 6.

Solomon, Book of Proverbs in the New American Standard Version of the Bible. (1995). Belgium: World Publishing.

Spann, M. G. & Calderwood, B. J. (1998). Increasing student success: an interview with Edward A. Morante. *Journal of Developmental Education, 22 (1), 16-18, 39.*

Stipek, D.J. (1988) *Motivation to Learn.* Englewood Cliffs, N.J.: Prentice Hall.

Stipek, D. J. (1996). Motivation and instruction. In *Handbook of Educational Psychology.* Berliner & Calfee (Eds.). New York, NY: Simon & Schuster Macmillan.

Stipek, D. J., Salmon, J. M., Givvin, K. B., Kazemi, E. (1998), The value (and convergence) of practices suggested by motivation research and promoted by mathematics education reformers. *Journal for Research in Mathematics Education,* 29 (4), 465-488.

Thorndike-Christ, T. (1991) Attitudes toward mathematics: relationships to mathematics achievement, gender, mathematics course-taking plans, and career interests. Unpublished manuscript, Western Washington University. (ERIC Document Reproduction Service No. ED 347 066).

Visser, J. & Keller, J. M. (1990) The clinical use of motivational messages: an inquiry into the validity of the ARCS model of motivational design. *Instructional Science,* 19, 467-500.

Weaver II, R. L. & Cottrell, H. W. (1988) Motivating students: stimulating and sustaining student effort. *College Student Journal,* 22 (1) 22-32.

Weiner, B. (1991). Metaphors in motivation and attribution. *American Pyschologist,* 46, 921-930.

Weiner, B. (1992). *Human Motivation: Metaphors, Theories, and Research.* Newbury Park, CA: Sage Publications.

Wolters, C. A. & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional Science*, 26, 27-47.

Zazkis, R. & Campbell, S. (1996). Divisibility and multiplicative structure of natural numbers: preservice teachers' understanding. *Journal for Research in Mathematics Education, 27, 540-563.*

Vita

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